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REGIONAL LANDFILL AND CONSTRUCTION MATERIAL NEEDS IN TERMS OF DREDGED MATERIAL CHARACTERISTICS AND AVAILABILITY. VOLUME I. MAIN TEXT

GREEN ASSOCIATES, INCORPORATED

PREPARED FOR
ARMY ENGINEER WATERWAYS EXPERIMENT STATION

MAY 1974

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Richard Reikenis
Victor Elias
Edwin F. Drabkowski

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13. ABSTRACT
A survey of the regional needs for landfill and construction material indicated that such needs vary substantially due to population shifts and economic growth of specific regions. Generally regional needs are determined to be substantially in excess of available volumes of dredged material, particularly in low-lying coastal areas. The survey also revealed that there are problems to overcome before dredged material is accepted for such usage. Regional investigations indicated that, given the projected quantities of dredged material, there can be large-scale disposal of dredged material on land sites. If these projects are planned and executed on a fixed time scale with well-integrated Government and private sector planning, desirable solutions to the dredged material disposal problem can be achieved. The following actions were concluded to be required to make dredged material a sought-after resource:

(1) A detailed inventory of all identified future development projects with regional development maps that show anticipated long-range needs of fill materials.

(2) Adoption of methodologies for selection and acceptance of sites for disposal and stockpiling of dredged material.

(3) Development of techniques for placing, control, and dewatering of fine-grained hydraulic fill material to decrease time of consolidation.

(4) Identification of the most economical application of present techniques for disposal of dredged material and, if necessary, development of new techniques.

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1. The contract report transmitted herewith represents the results of one of four research efforts (work units) initiated to date as part of Task 5C (Disposal Area Reuse Research) of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 5C is included under the Land Disposal and Equipment Project of the DMRP, which is concerned with both the environmental effects of land disposal operations and facilities as well as new concepts for land disposal, particularly those involving consideration of dredged material as a resource rather than simply a waste product.

2. A particularly attractive concept for mitigating the land requirements for disposal sites is to increase the life expectancy of sites through the periodic removal of dredged material for use elsewhere. Optimally, sites could be used indefinitely or be truly permanent disposal facilities; however, continuing needs for the dredged material must be identified. Moreover, procedures must be available for processing and/or rehandling the materials, and mechanisms must be present for marketing the materials under known constraints.

3. The investigation reported herein addressed itself to identifying regional variations in and potential for two promising uses of dredged material taken from disposal sites or directly from dredging projects, i.e. landfill and construction materials. The contracted effort was accomplished during a 7-month period and was nationwide in scale, involving hundreds of contacts, in person or by correspondence, with persons with varied interests and functions in organizations from Federal to local in scale.

4. Regional needs for landfill for a variety of functions, including urban, environmental, economic, and resource land uses, were generally found to be in excess of projected volumes of dredged material to be available from navigation improvement projects. While there are problems

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to be overcome, particularly in regard to material placement, control, and dewatering to facilitate consolidation, there is good probability for widespread use of dredged material for landfill if the projects are planned and executed on a fixed time scale with well-integrated Government and private sector planning.

5. Construction material deficiencies currently exist in parts of the country and additional ones are expected to develop; however, the majority of available dredged material is unsuitable for use in quantities needed by suppliers for competitive operations.

6. The study concludes that Corps districts need to cooperate to the fullest extent possible with local planning agencies in selecting disposal sites with a view of their being compatible with and suitable for incorporation into regional and local land use plans. It also concludes that one practical scheme for making dredged material more readily available is to stockpile it at strategic locations. However, for a concept of this type to be viable, it must incorporate facilities for drainage, dewatering, and separation. Research efforts under the DMRP already have been initiated to develop such concepts which could make stockpiling a reasonable alternative in certain situations.

G. H. HILT
Colonel, Corps of Engineers
Director

DREDGED MATERIAL RESEARCH PROGRAM

CONTRACT REPORT D-74-2

REGIONAL LANDFILL AND CONSTRUCTION MATERIAL NEEDS IN TERMS OF DREDGED MATERIAL CHARACTERISTICS AND AVAILABILITY

VOLUME I: MAIN TEXT

by

R. Reikenis, V. Elias, E. F. Drabkowski

May 1974

Sponsored by Office of Dredged Material Research

Conducted for U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi

Under Contract No. DACW 39-73-C-0141

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FOREWORD

This report presents the results of an investigation into landfill and construction material needs throughout the United States related to the characteristics and availability of dredged material. This investigation was conducted as part of the Corps of Engineers Dredged Material Research Program (DMRP) (ODMR No. 5C04), which is being planned and managed by the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. The DMRP is sponsored by the Office, Chief of Engineers (DAEN-CWO-M) and was formally authorized by letter, "Study Program for Disposal of Dredge Spoil" dated 27 December 1971.

The portion of the study reported herein was conducted during the period of June 30, 1973 through January, 1974 in the office of Green Associates, Inc., Towson, Maryland, under the direction of R. Reikenis, principal, V. Elias, project manager and E. F. Drabkowski, planning analyst. In addition to the aforementioned, the report was prepared by engineering analysts of the study team, Messrs. J. H. Simons, J. D. Hoover, T. L. Watchinsky, S. Gupta, M. Daniel, and L. Moser.

Individual team members had primary responsibility for major technical sections of the report. E. F. Drabkowski prepared the "Gulf States Region" and was a primary contributor for the " Introduction", "Conclusions" and "Recommendations". J. D. Hoover prepared the "South Atlantic Region" and "Pacific Coast Region". T. L. Watchinsky prepared the "North Atlantic Region", "Great Lakes Region" and along with V. Elias and S. Gupta prepared "Availability and Utilization of Dredging as Construction Material." All sections were prepared after team discussion to consolidate pertinent ideas.

The Directors of WES during the study and preparation of the report were BG E. D. Peixotto, C. E., and Col. G. H. Hilt, C. E. Technical Director was Mr. F. R. Brown. Dr. John Harrison was Chief, Office of Dredged Material Research, and Dr. R. T. Saucier was Assistant Chief, ODMR. The study was conducted under the general supervision of Mr. R. L Montgomery, Project Manager, and Mr. C. C. Calhoun, Jr., Acting Project Manager for Land Disposal and Equipment Research. Mr. T. R. Patin was the Contract Manager.

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Appendixes constitute a separate volume of this report.

SUMMARY

Regional needs for landfill and construction material vary substantially due to population shifts and economic growth of specific regions. In general, regional needs can be determined to be substantially in excess of dredged material available volumes. This is particularly high-lighted in coastal low-lying areas. Dredged material characteristics in some regional areas may pose, with present transportation and handling techniques, problems in being viable with currently planned projects requiring immediate use of fill material having some desired load carrying capacity.

Regional investigations indicate that, given the projected quantities of dredged material, there can be large scale disposal of dredged material on or at fast land sites. If these projects are planned and executed on a fixed time scale with well integrated Government and private sector planning, desirable solutions to the dredged material disposal problem can be achieved. The Gulf States' population is expected to increase at greater rates along the coast, increasing pressure for land development. In addition to residential, recreation and service facilities, land needs for industry and specifically oil related handling and manufacturing can be translated to fill requirements exceeding possible dredged material supply, which is estimated to be annually from 130 to 200 million cubic yards The New Orleans, Galveston and Mobile areas provide the bulk of the dredged material, predominantly silt and sand mixtures.

Relatively better quality materials are found in new work dredging for river and channel development. Environmental considerations, size of projects and type of material have been deterents to utilization of dredged materials in the past. More ingenious fill placement techniques must be engineered for greater acceptance of dredged material for landfill requirements There is substantial indication confirmed by many responses cited in this report that pressures of growth, particularly in the states of Mississippi, Alabama and Louisiana, have brought forth many engineering solutions for land development made economically and environmentally feasible utilizing dredged materials.

It may be expected that the vast extent of low-lying land and marsh areas found in the Gulf States invite an almost limitless need for fill material. A judicious selection from among these many available sites with due regard for environmental and economic limitations presents the best hope for success.

Projects preferred in reference to desire of dredged material use were ports and port-related industries, industrial parks, wildlife refuges, marine organism nurseries, shell fish beds, beach nourishment, park development, levee construction, flood and hurricane control structures, artificial islands, sand and gravel extraction, new town development, sanitary landfill cover, airfield, highway and other construction fill material uses. As indicated by Matrix 2A, urban and environmental uses of developed lands are preferred, followed by resource and economic uses. Notable projects requiring large quantities of fill in focal areas are: (1) in New Orleans, Louisiana, Pontchartrain town-in-town and New Orleans port, to be located at the Mississippi River - Gulf outlet, (2) in Mobile, Alabama - Battleship Park will require extensive fill, and (3) Jacintoport in Mobile, Alabama.

The fill required for the described proposed land developments in the Gulf States identified in this report approximate some 800 million cubic yards. If all dredged material could be used for this planned purpose, close to five years of continuous projected dredging activities would be needed to meet this demand.

Coastal land formations of the South Atlantic Region are governed by the Atlantic Coastal Plain with shorelines exhibiting embayments and well developed estuarine features. Population increases along the coastline, except in Savannah, Georgia, indicate a continuous growth trend.

Approximately 25 million cubic yards are dredged annually in the South Atlantic Region. Much of this dredged material could be useful in landfill operations, should overall placement costs, including transportation and handling, be planned to compete with existing borrow material costs. As indicated by Matrix 3A, urban uses for dredged material are preferred, followed by environmental and resource uses. Proposed usage presently parallels existing usage of dredged material as beach nourishment for St. Lucie, Key West, Palm

Beach and Duval Counties in Florida, and some areas in Georgia, South Carolina and North Carolina (Cape Lookout). Hurricane protection projects for Hillsborough and Biscayne Bays, Florida; North River. Topsail Beach, Surf City and the Brunswick Beach, North Carolina.

Marina construction and bulkhead extentions requiring dredged material were reported in the Carolinas. In Savannah, Georgia, an offshore island is proposed for trans-shipment terminal construction. In Jacksonville, Florida, Blount Island will be developed for construction assembling and testing of floating nuclear power plants.

Flood control, particularly in South Florida, for low-lying areas would require substantial amounts of fill to enable development of land for projected growth. If all projected dredged material could be used for landfill, it would take, at the present annual rate of dredging, approximately 100 years to meet the demands of growth.

The most frequently suggested usages of dredged material in the North Atlantic Region were as fill for strip mined areas and abandoned quarries, and sanitary landfill cover. If the transportation and environmental problems associated with these uses can be solved, these proposals represent a substantial use that could alleviate disposal problems for many years to come.

In addition to these suggested usages, many large projects are in planning in the North Atlantic Region that will require large quantities of dredged material. Included in these are the Hart-Miller Island Diked Disposal Area and the proposed redevelopment of the Inner Harbor at Baltimore, the Delaware Bay Superport Proposal, and the Hackensack Meadows Development Plan. There also exists the possibility of using suitable dredged materials to alleviate shortages of construction materials at several locations in the North Atlantic Region. Several research projects conducted or still in progress suggest that selected dredged materials can be used in making brick and other construction materials, although from the standpoint of volume of material used this proposal does not represent a significant contribution.

Shipping at lake ports is of vital importance to the Great Lake Region economy, even though ports are icebound during part of the winter. Focal cities investigated in this

report for the Great Lakes Region were: Buffalo, New York; Cleveland, Sandusky and Toledo, Ohio; and Detroit, Michigan. The population migration trends in the cities are mainly negative. This is explained by trends toward population shifts to fill in the spreading belt between Buffalo and Chicago, which will form an uninterrupted chain of development across the Great Lakes Region. The north-central portions of Ohio, Pennsylvania and western New York State will show the greatest increase in population growth.

Approximately 15 million cubic yards of material are dredged annually in the Great Lakes Region. The Region has an abundance of construction material sources of sand, gravel and clay for brickmaking. Dredged material disposal as landfill may be economical only along waterfront sites. Such sites are more difficult to obtain since land values of properties adjacent to shorelines are rapidly increasing.

Presently, permits have been requested for a 400 acre diked disposal island in Toledo Harbor to be compatible with the Toledo-Lucas County Port Authority's expansion plans for docking space and related industrial sites. The Buffalo District is involved in a proposal by the City of Huron to create a dredged fill park in the Harbor Area. Similar plans for fill to create recreational areas exist for Conneaut and Fairport Harbors in Ohio.

The responses suggesting dredged material uses in the Great Lakes Region most frequently include reclamation of strip mines, quarries and cover material for sanitary landfills. Shoreline erosion protection is required for 150 miles of critically eroded lake shorelines.

The City of Buffalo is proposing to fill about 50 acres of Lehigh Valley Basin to create a wildlife area and park development along the shoreline. Expected commercial and residential development on Grand Island will require fill to raise low-lying tracts of land.

The Amherst area of Buffalo will be the site of the new University of Buffalo campus, which will also promote residential and commercial development of this area.

The amount of fill area development using dredged material and development of construction materials, if competitive with available borrow, could easily utilize all available dredged material in the Great Lake Region. The greatest requirement for this area is long range multi-purpose land use planning to enable dredged material fills to be competitive with standard grading and fill operations.

The Pacific Coast Region includes the three focal cities of Seattle, Portland and San Francisco.

Los Angeles and San Diego were not included in this report because a sizeable portion of the dredged material obtained in these two areas is being used for beach nourishment. The remainder of the material dredged in this Region is unpolluted and is used as land fill with little difficulty.

Pacific Coast population growth is highlighted by expansion into urban fringes. By the year 2000, it is expected that the population will be double that of the present. This substantial growth and the resulting demand for facilities equivalent to the last 200 years of growth will have to be accommodated.

Over 40 million cubic yards are dredged annually from the Pacific Region. A greater knowledge of dredged material availability and quality, as well as placement technology, could be made available to regional, local and private planning agencies. These agencies could then supply a substantial input of uses for dredged material in potential landfills.

Stockpiling dredged material for utilization in construction is a relatively common practice in the Seattle District.

The San Francisco District is presently studying the feasibility of creating landfills for optimum dredged material disposal and land uses in the San Francisco Bay area, extending 60 miles inland. Crossover Systems, Inc. of San Francisco, California is experimenting with the extraction of minerals and metals from dredged material.

Several factors which hinder the use of dredged material in landfill projects are transportation, quality, economics and environmental constraints. Environmental constraints and the passage of recent Shorelines Management Acts, in the three states, have stopped or severely curtailed many land disposal projects. There is also a general negative outlook in considering the use of dredged material as a resource in the Region.

In all three focal cities of Seattle, Portland and San Francisco many areas along the coastlines have been filled and developed with dredged material. Port facilities, urban, industrial sites, roadway embankments, dikes-levees, rookeries, parks and recreational areas

have been developed on dredged fill material. It has also been utilized in beach nourishment, as a source of sand and gravel, and stockpiled for resale. It has proven beneficial in the creation of new clam beds at Coos Bay and Yaquina Bay, Oregon.

Areas in the Pacific Region requiring large amounts of fill material prior to utilization are: (1) Green River Valley in Washington, an area being considered for development that must have "preload fill." Dredged material could be stockpiled at these sites while being used as a "preload fill." Upon completing its initial purpose it could then be removed for use elsewhere if its characteristics so warranted. (2) Potentially large quantities of dredged material could be utilized in the preservation of delta levees of the San Joaquin-Sacramento River Delta in California. This land is gradually subsiding and most places are below the water level in the sloughs. (3) The San Francisco Bay Conservation and Development Commission has identified approximately 1900 acres of land which could use filling, and could accommodate 600 million cubic yards of material. Also noted are 30 acres along San Francisco Bay which would require filling to some degree, although there is great local opposition to any further filling of San Francisco Bay. (4) The Port of Portland is presently developing 5000 acres in its "Rivergate Project." Material is being pumped directly from the Columbia River for fill. It is estimated that another 20 million cubic yards is still required for completion of the project. Ross Island in the Portland area is presently being removed by mining operation. Large quantities of material could be used to restore this island to a beneficial condition.

Investigations of the current status of sand and gravel resources throughout the United States indicate that deficiencies exist in the Pacific Northwest and Atlantic Coast Regions. Estimates of life expentancies of present sources by operators and sand and gravel associations reveal that additional deficiencies will develop in the near future. In many of these areas dredged materials of a suitable nature are available and can be used to satisfy at least part of the deficiencies although some processing of the material may be necessary.

Local deficiencies existed in 1970 in New York and Pennsylvania. Boston, Mass., also obtains some sand and gravel supplies from sources as far as 70 miles away.

It may be expected that the Baltimore-Washington Area soon will join the sprawling metropolitan areas, where development will preclude utilization of present sources, requiring hauling of material from other states (barging from North Carolina).

In the South Atlantic and Gulf states, Alabama and the specially populous coast of east Florida (Jacksonville, Florida, barging from South Carolina) have shortages of local sand supply.

The most critical supply problem for Alabama is the deficiency of large aggregate of the 1 to 1½ inch size.

In the Great Lakes Region, the western parts of Pennsylvania and New York show some local deficiencies in aggregate material.

Aggregate usage in the Pacific Coast Region far exceeds the national average (4.6 tons of aggregate per capita). The 1970 needs of 7.2 tons per capita were satisfied in all three states, but local sources, particularly in the Portland area are beginning to deplete.

The majority of dredged material near major population areas is unsuitable for use in the sand and gravel industry. Before sand and gravel operators will avail themselves of dredged material resources, at least a ten year supply of material must be guaranteed.

A possible method of operation would be to deposit suitable material in a confined disposal area, which could serve as a base of operations and stockpile for future use of the material as aggregate. It has to be borne in mind that such locally obtained aggregate material will have to compete with upland material, often obtained from select quarries and borrow pits.

As a landfill material, dredged material should have a competitive edge in large projects. As illustrated in this report, projects like Hackensack Meadowlands in New Jersey, and East New Orleans Airport can be economically pursued with the use of hydraulic fills.

The physical characteristics of dredged materials present certain problems in connection with their use as landfill material. Chief among these problems are extremely high water content found in fine-grained materials and the excessively long consolidation time resulting from this water content.

The success of dredged material use as a resource lies mainly in landfill creation. Need for much dredging is created by continuous natural land leveling processes. The predominantly fine-grained material has a long dewatering phase which makes landfill creation by dredged material a desirable goal only if a dredged material placement program can be coordinated with anticipated land developments for urban, economic, environmental or recreation projects.

A detailed inventory of all identified future development projects, as well as an attempt by Regional planners to relate the development to the overall desire in the Region for growth and to locate fills to be relatively compatible with present and future land use would be a first step in determining feasibility of land fill areas for possible dredged material uses.

Regional development maps, showing anticipated long-range needs of fill material, similar to macro presentation in this report, can identify possible landfill projects with input obtained from all Federal, State, Local and private organizations involved directly or indirectly with land development. This approach may assist Districts in establishing the first list of possible candidate sites, for dredged material containment sites.

The adoption of methodologies permitting selection and acceptance of a site for disposal and stockpiling of dredged material will be a great step to the solution of dredged material use as a resource. Studies of methodologies for placing, control and dewatering of fine-grained hydraulic fill material to decrease time of consolidation, to find more economical application of present techniques and development of new techniques will make dredged material a sought after resource in all of these studied regions.

A balance between accommodating man's needs as well as nature's needs can be achieved with coordinated efforts for both public and private benefit by appropriate Districts and responsible regional planning agencies with a vision of America tomorrow.

PART 1. INTRODUCTION

Purpose and Scope of Study

1. Section 123(i) of Public Law 91-611 authorized the Chief of Engineers to carry out a comprehensive program of research, study, and experimentation related to dredging and the disposal of dredged material. Phase III, Research Program Accomplishment, referred as DMRP, Dredged Material Reserach Program, was assigned to WES, where it is conducted by a full-time interdisciplinary study team, designated as the Office of Dredged Material Research (ODMR).

2. A proposal in response to RFP No. DACW39-73-R-0016 was submitted by Green Associates, Inc., on May 21, 1973 and was accepted on June 30, 1973 to accomplished this study. The study falls within Task 5C, Disposal Area Reuse Research, as project 5C04, Study of Regional Landfill and Construction Material Needs in Terms of Dredged Material Characteristics and Availability.

3. The purpose of this study is to evaluate regional needs for landfills and construction materials without initial consideration of material quality, cost, and other charactersitics. By uncovering unmet landfill needs and unsatisfied demands for construction materials, it becomes possible to consider the use of dredged material as a resource material to meet these unsatisfied requirements. Should sufficient demand warrant the use of dredged material, the feasibility of exploring the ways and means to treat dredgings, separate the granular materials from the fine silts and clays, improve the dewatering methods, and find economical means of transportation, would become justified. Additional costs incurred in preparing and delivering desired quality material from dredged sources would become the necessary increased cost to meet the demands of more stringent environmental quality controls.

4. One primary intent is to consider dredged material as a resource that can be accepted as an economically viable asset rather than an unwanted waste product. To this end, dredged material is to be defined and discussed as a supplementary material resource dredged from our rivers, harbors and ship channels that can be "recycled" as a beneficial

compliment to our environment. The ideal situation will occur when dredged material disposal areas are developed as holding or processing areas for material that is later removed for beneficial purposes, freeing the disposal area for refilling.

5. The scope of this study is national in coverage and follows two primary thrusts:(a) a regional assessment of landfill needs and (b) an evaluation of construction material needs on a regional basis. Material characteristics and availability are also reviewed on a regional basis to investigate probable differences and considerations in the disposition and use of dredged material. Each regional assessment is presented to expand on the understanding of area knowledge, availability, general characteristics, interest, need, and use of dredged materials.

6. The study was designed to investigate present and potential landfill needs and construction material needs within 100 miles of major dredging activities. The uses being made of dredged material, for what purposes and in what quantities were evaluated in each of five selected regional areas.

Methodology

7. In order to obtain a broad regional sampling of landfill needs, information was secured from both public and private organizations with specific knowledge of the geographic region. Within the defined 100 mile area, regional planning groups, councils of government, chambers of commerce, port authorities and various state and local governmental agencies were contacted.

8. Regional planning commissions and councils of government were primary agencies of interest because of their specific responsibilities in preparing long range plans for their region. Chambers of commerce provided information on the plans prepared by the private business sector regarding land developments. The state agencies contacted included those involved with highways, ports, conservation, fish and wildlife and economic development.

9. Interviews were conducted in each of the U.S. Army Corps of Engineers offices selected within the study regions. Information was obtained as a means to make an assessment of current Corps activity in terms of identifying and actively pursuing

other-than-conventional uses for dredged material removed in the course of harbor and channel maintenance projects. Additionally, the awareness of potential "user" groups was assessed through interview, correspondence and telephone calls. These included the agencies referred to above. Determination of the availability and quality of dredged material potentially useable for landfill and construction was made through contact with the Corps District personnel and through examination of pertinent documents.

10. The data and information gathered through these acitvities was subsequently subjected to analyses employing matrices, extrapolations of the information and data, and presentation in graphic format.

Regional divisions

11. The coastal areas of the United States were divided into five regions as shown on Plate 1 and are defined as follows:

a. Gulf States - Texas, Louisiana, Mississippi, Alabama and the Western parts of Florida.

b. South Atlantic - Eastern half of Florida, Georgia, South Carolina, and North Carolina.

c. North Atlantic - Virginia, Maryland, eastern half of Pennsylvania, eastern half of New York, New Jersey, and Delaware.

d. Great Lakes - Western half of New York, western half of Pennsylvania, Ohio and Michigan

e. Pacific Coast - Washington, Oregon and California

12. Corps Districts. Within each defined region several U.S. Army Corps of Engineers District office locations are represented. Listed below are the District Offices within the above regional divisions:

a. Galveston, Texas; New Orleans, Louisiana; Mobile, Alabama.

b. Jackosnville, Florida; Savannah, Georgia; Charelston, South Carolina; Wilmington, North Carolina.

c. Norfolk, Virginia; Baltimore, Maryland; Philadelphia, Pennsylvania; New York, New York; Boston, Massachusettes.

d. Buffalo, New York; Detroit, Michigan; Chicago, Illinois.

e. Seattle, Washington; Portland, Oregon; San Francisco, California; and Los Angeles, California.

13. Plate 1 generally shows the geographic coverage of the coastal portions under jurisdiction of the referenced Corps District Offices. Only those Corps Offices surveyed are included on this map. Each of the District office cities also served as a focal point of discussion regarding inland uses for dredged material. In these cities, the respective port authorities, chambers of commerce and planning commissions were contacted along with other pertinent coastal or bay related study groups and commissions.

14. U.S. Army Corps of Engineers District Offices not visited during the course of the study were Los Angeles, California; Boston, Massachusetts; and Chicago, Illinois. The Los Angeles District has few problems with dredged material disposal. This is largely due to the unpolluted nature of the local material. In the Boston District, the annual amount of dredged material is insignificant in terms of evaluated consideration for upland disposal potential. The Chicago District was not surveyed since most of the dredged material from the Great Lakes Region eminates from Lake Erie which is covered by both the Buffalo District and the Detroit District offices.

15. Physiography. A relationship between the defined regional divisions and material physiographic characteristics plays an important role in an area's need and demand for fill material. One general assumption regarding landfill need is that low lying land areas, areas subject to subsidence, sinks and depressions, and areas with mineral resources conducive to strip mining or quarrying would be suitable areas of consideration for landfill need. Also, areas of sufficient topographic relief where fill materials are generally available can be eliminated for consideration of use. To aid in the comparative evaluation of physiographic characteristics to this study's selected regional divisions, Plate 2 presents a generalization of the physiographic areas of the United States.

16. Coastal zones. As a means to delineate and define this study's 100 mile inland area of consideration, "coastal zones" were established. Each of the five regional divisions were further subdivided into four belt-like zones parelleling the coast and harbor areas and reflecting inland distances of 25 mile increments. These zones are defined below in generalized terms in order that the descriptions can be validly applied throughout the coastal regions.

a. Zone A: Zone of current and intensifying development. Marked by extensive wetland (marshes and swamps) in the Gulf States and Atlantic regions, flat terrain in the Great Lakes region and more rugged topography in the Pacific region. Ranges to approximately 25 miles inland from nearest harbor and coastal dredging operations.

b. Zone B: Zone of moderate to low density development marked by more extensive topographic variation and rolling terrain. Ranges from 25 miles to 50 miles inland from harbor and coastal dredging operations.

c. Zone C: Zone of generally low development intensity with extensive topographic variation (except in Florida). Ranges from 50 to 75 miles inland from harbor and coastal dredging operations. Urban development in medium size cities occurs at this range in California.

d. Zone D: Zone of variable development intensity. Urban development concentrations in medium sized communities appear along the Atlantic coast. Ranges from 75 to 100 miles inland from harbor and coastal dredging operations. This zone does not occur in Florida.

17. These coastal zones collectively comprise the areas of analysis in each study region. Graphic illustrations of these zones are included elsewhere in the text. In most instances all study data is related to these coastal zones. Population and area statistics by zone are based on county data as prepared by the U.S. Bureau of the Census. If one-half or more of a county came within the 25 mile line, the entire county area and population count

were included within that zonal increment. Therefore, the 25 mile designations for coastal zones are only approximate. However, the width of each coastal zone contains at least one whole tier of counties.

Matrix Analysis.

18. Matrix identification. The matrix format is intended for use as a portrayal of value judgements suitable for use as a guide to further investigations. Three matrices were used in the study, viz, Sampling of Landfill Projects, Potential Landfill Projects and Quantitative Assessment. Each matrix applies weighted values based upon judgement of the landfill use or potential use as shown in the following diagram.

MATRIX	*VALUE JUDGEMENT*	*WEIGHT*
A - Sampling of Landfill Projects	Existing Uses	3
	Proposed Uses	2
	Potential Uses	1
B - Potential Landfill Projects	Greatest Potential	3
	Moderate Potential	2
	Least Potential	1
C - Quantitative Assessment	Over 2,500.000 cu. yds.	3
	500,000 to 2,500,000 cu. yds.	2
	less than 500,000 cu. yds.	1

19. The values in Matrix A relate to project status in terms of land use activity as existing, proposed or potential. Existing projects are those that have been built on landfill composed mostly of dredged material either created for that specific use or eventually developed because of the availability of the created land. Proposed projects are those that are to be built on landfills of dredged material. Potential projects are those reported as future possibilities that could use dredged material as the basic landfill.

20. Matrix A considers existing developments to be of a higher value (on a scale of 3, 2, 1) than either proposed or potential developments. This reasoning suggests that where projects exist, a higher level of acceptability can be assumed and compared between

regions. Specific applications of fill to develop residential areas or beach nourishment projects, or islands, etc., are evaluated with average values obtained to show the level of landfill interest within the region by District. These values were applied only when reported by the agencies contacted. Where values are not given information regarding that specific land use activity was not reported. However, this does not necessarily mean that actual use is not being made of landfills for those specific land use categories.

21. As much as possible, the value judgements are based on factual information although, a certain amount of subjectiveness may be involved in deciding on uses in each of the coastal zones defined for analysis.

22. Matrix B, Landfill Potential, serves to evaluate and assess the potential requirements for landfill in each of the Districts by coastal zone. In a similar manner as followed in Matrix A, the higher values reflect a greater potential with lower values reflecting a lesser interest or need.

23. Value judgements are based on observed growth trends, physiography and regional planning considerations for future development. The results of the matrix analyses are given as mean values for major land use categories. This analysis should serve as a guide to the use and area of emplacement of dredged material.

24. It follows from the analysis of existing landfill projects (Matrix A) and landfill potential (Matrix B), that a level of material quantity can be determined. In areas of use experience and high evaluated potential, a relatively high degree of demand and/or need is assumed to exist. Matrix C, Quantitative Assessment, presents an analysis of probable material quantities involved in the described reported projects. Further input to this analysis is obtained from comprehensive regional development plans analyzed in sample parts of the region. From this analysis it can be established that certain parts of the Corps District areas can use greater amounts of fill materials than other parts.

Land Use Classifications

25. The land use terms used in the matrices and referenced in the regional assessments are herewith defined. There are four main categories of land use to identify the

major regional land use developments. Each of these categories are further divided into functional land use activities. Only 25 separate activities have been selected which appear to represent all existing and proposed uses for landfill and construction materials. For convenience in evaluation and comparison, each matrix and land use map reference utilizes these same land use categories and functional activities.

a. Urban Developments: Land uses comprising the concentrated community development pattern including all associated activities except large scale industrial developments, extensive park areas and public open space, and agriculture. Classification includes housing, general commercial functions, community educational and cultural facilities, commercial resorts and amusements, parking lots and public garages.

b. Economic Developments: Land uses that pertain to employment and major business functions, such as industry, transportation, communication, utilities, military installations, and manufacturing enterprise.

c. Environmental Developments: Land uses established to enhance the environment or to preserve areas and open space for general public use and recreation or conservation.

d. Resource Developments: Land uses related to the land for purposes of food and fiber production, mineral extraction, aggregate, concrete products and created land.

26. An expanded list of land uses is included as the most often referred to activities needing fill materials. These uses are categorized as to their functional relationship to the major land use development categories that appear in the matrices.

FUNCTIONAL LAND USE CLASSIFICATION

URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
Housing	Public Parks-Recreation	Industrial	Agricultural
Retail Shops	Wildlife Areas	Transportation	Forestry
Cultural Facilities	Marine Nurseries	Highways	Sand-Gravel
Educational Facilities	Rookeries-Refuges	Harbors	Brick Making
Parking Lots	Nature Exhibitions	Airports	Ceramics
Commercial Resort	Marsh-Wetland	Utiliites	Aggregates
Development	Beach Nourishment	Communications	Grazing-Ranges
Community Facilities	Flood Plain Management	Canals-Locks	Asphalt
	Sanitary Landfill	Military Installations	Concrete Mix
	Strip Mine Fill	NASA	Stockpiles
	Deep-Shaft Minefill	Levees	Artificial Islands
	Borrow Pit Fill		General Land
	Quarry Pit Fill		Reclamation
	Public Resort		(not planned or
	Development		classified for
	and Group Camps		immediate use)
	Watershed		
	Solid Waste Disposal		

Socio-economic profile

27. Demands for development, construction, expansion and continual urbanization can be translated into needs for land and, where necessary, landfill and newly created land. These demands are generally a function of population growth and/or economic expansion. Both of these functions are somewhat dependent on each other and entirely dependent on land availability.

28. To outline where the population and economic activity is concentrated would serve to indicate areas in need of the greater amount of aggregates, construction materials and landfills. Therefore, Plates 3 through 6, prepared by the U.S. Census Bureau, are reproduced and included at the end of the text. The four plates show population distribution in the U.S. The purpose of these illustrations is to emphasize the heavy concentration of population, density and manufacturing activity along the coastal regions of the nation. The population trends map serves to show that growth toward and within the coastal counties throughout the country is a prominent trend.

29. The regional analyses reported in the text relate these socio-economic factors to each coastal zone within the respective region. These data indicate area location and volume of need for fill materials. Most often the greatest concentrations, and therefore, the greatest demands for fill are located within the first 25 mile zone from harbor and coastal dredging operations.

Existing development trends

30. Trends of growth are also explained by use of population data. The percent change in population between 1960 and 1970 will show whether an area is continuing a pattern of growth or stability. This is further determined by the percent change in net migration. Negative numbers show that population is out-migrating even though an area may show numerical increases over the preceeding decade. The regional analyses show that there are areas in the coastal zones that are slowing down in over all population growth.

31. The basis for evaluating development trends was extrapolated from Standard Metropolitan Statistical Area (SMSA) data. As of February 1971, there were 243 SMSA's in the United States. Data for the SMSA's located in the five study regions are reported in the

text. Plate 7 is included to show the distribution of SMSA's which reflect the emphasis on coastal region concentration. One exception is the urban belt between New York and Chicago.

Comprehensive plans analysis

32. Within each region, sample comprehensive plans were selected to show the relationship between recommended future land development and the need for landfill. In many areas future land use developments are recommended on land that will require improvement in order to be suitable to support development. Examples include future use proposals on flood plains, swamps and other low lying land areas, as well as future considerations for developments on water bodies and other areas not normally viewed as developable without prior site preparation. Many plans particularly show future industrial sites on the flood plain, airfields in lakes or along rivers, residential developments in marshland, roads through swamps and commercial areas in low depressions. It was assumed that if these plans are to be carried out then landfills will be a major requirement.

33. Each selected plan was converted into the four primary land use development categories and compared to the area's physiographic features. Where a specific low area, marsh or swamp was shown to be proposed for some other future use, that area was delineated as a colored area, calculated for fill at an assumed depth and presented to show typical need for landfill in that region.

34. These examples are given only as a preliminary investigation into probable long term need. However, they also serve to show that the long range planning recommendations of regional planning agencies can and should be related to the activities of the Corps of Engineers District offices. Coordination between these agencies can achieve beneficial results in terms of creating new land for public benefit at locations determined to be deficient.

Appendix Material

35. The most direct input into this study was made through telephone contact and written correspondence. Therefore, to get the most out of the study, selected letter responses are included in Appendix A so that an understanding of the various area needs, interests and concerns can be made. Summary notes on the telephone conversations made in each region are also included in Appendix C along with memoranda of the visits of the Corps District offices (Appendix B). These will be helpful guides permitting a broad overview and insight into the national attitude on dredged material. Because of the considerable volume of this correspondence, appendices A, B, C, and D have been reproduced in limited edition as a separate volume. While the supply lasts, copies are available upon separate request. Also included in the separate volume as Appendix D is supplemental data pertinent to the theme of this report.

PART 2. GULF STATES REGION

General Characteristics

Physiography

36. For the most part, the Gulf States region is located in the Coastal Plain province of the United States as shown on Plate 2. The southern portions of Texas and Alabama and all of Louisiana, Mississippi and Florida are in the Coastal Plain. The exceptions being the northwest part of Texas which is divided into the Great Plains and Central Lowlands provinces, and the northeast part of Alabama which is in the Piedmont province of the Appalachian Highlands.

37. The Coastal Plain is an elevated sea bottom with low topographic relief and extensive marshy tracts. It stretches along the Atlantic Seaboard and Gulf Coast and penetrates inland from 100 to 200 miles. More than half of the Plain is below 100 feet in elevation with much of the area adjacent to the Gulf of Mexico lying below sea level.

38. The Gulf Coast section of the Plain can be divided into eastern and western sections separated by the Mississippi Alluvial Plain. The east and west Gulf Coast sections are similar in structure and general topography which is essentially level and sloping toward the Gulf. An identifiable string of low bluffs paralleling the shoreline marks the location of an elevated former beach. Extensive marshy tracts appear between this bluff line and the shore.

39. The Mississippi Alluvial Plain is a broad flat floodplain 500 miles long from 50 to 100 miles wide consisting of soft, generally wet, fine grained sands and gravels. This alluvial floodplain is subject to frequent flooding and requires careful preparation prior to development.

40. Figure 2.1 graphically displays the "coastal zones" for the Gulf States Region. The contour-type line delineates a distance of 25 miles from the coastal shoreline. Each 25 mile "zone" is identified by letters A through D which represent the 100 mile limit established for study purposes. U.S. Army Corps of Engineers Districts include those served by District offices located at Galveston, Texas; New Orleans, Louisiana; and Mobile, Alabama.

Socio-Economic Profile

41. A review of social and economic activity provides a basis to scale probable demands for construction and landfill materials. Needs are generated by people in the locations in which they are found and the level of this need is predicated somewhat on the intensity of development and future growth trends. Levels of development can be determined from selected population and economic indicators such as population distribution and density, family income, manufacturing values, retail sales and agricultural productivity. These indicators, when compared to past years, can also be used to estimate future trends.

Population Distribution and Density

42. Urban and rural population distribution recorded by the U.S. Census Bureau as of 1970 is illustrated by Plate 3. It can be noted that population in the Gulf States is mainly concentrated along the coast and at principal coastal city centers. It also can be noted that in areas where the landform is not suited to development no concentration of population is evident.

43. The statistics given in Figures 2.2 and 2.3 support the illustration of population distribution (Plate 3). The greatest number and concentration of people are located within the first 25 mile zone (Zone A). Zone B, the next 25 mile band, shows a dramatic drop in numbers of people with some states (like Mississippi) showing a noticeable number reduction in this second zone. Zones C and D are fairly uniform in population numbers with some increases noted as other urban centers further inland are approached. Louisiana is an example with the increased population concentration around the City of Baton Rouge. Mississippi and Alabama show increased population because of the additional land area added as the distance from the coast increases. Another observation shows that the population movement is following a southerly and westerly course across the U.S. This movement suggest that the Gulf States will be receiving increasing population numbers from both in-migration and natural means (an excess of births over deaths). Since the bulk of this growth will most likely concentrate along the coast as evident from past trends, it is reasonable to consider that dredged material can be a useful resource to develop needed land area in acceptable locations along the coast.

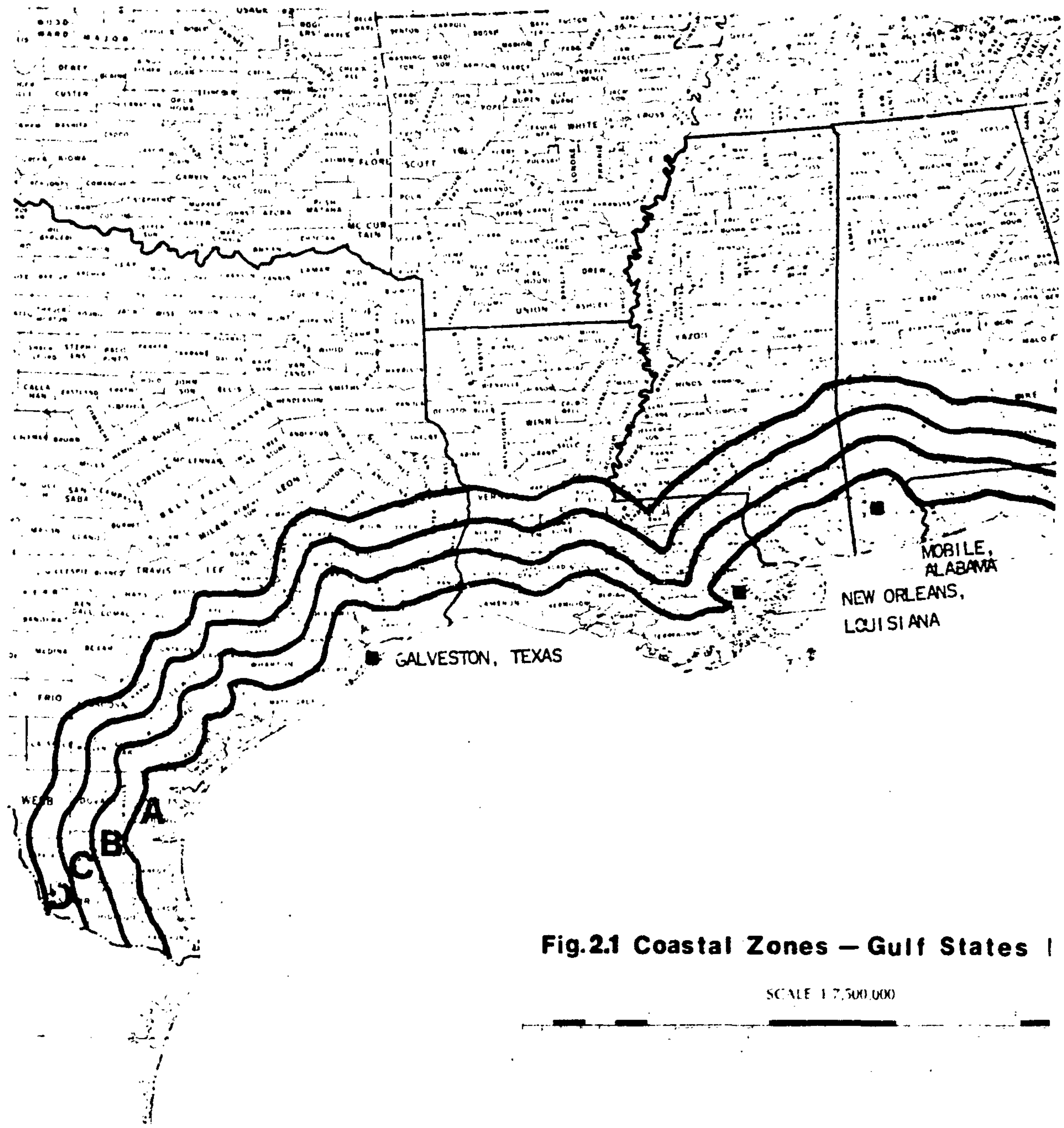


Fig.2.1 Coastal Zones — Gulf States I

SCALE 1:7,500,000

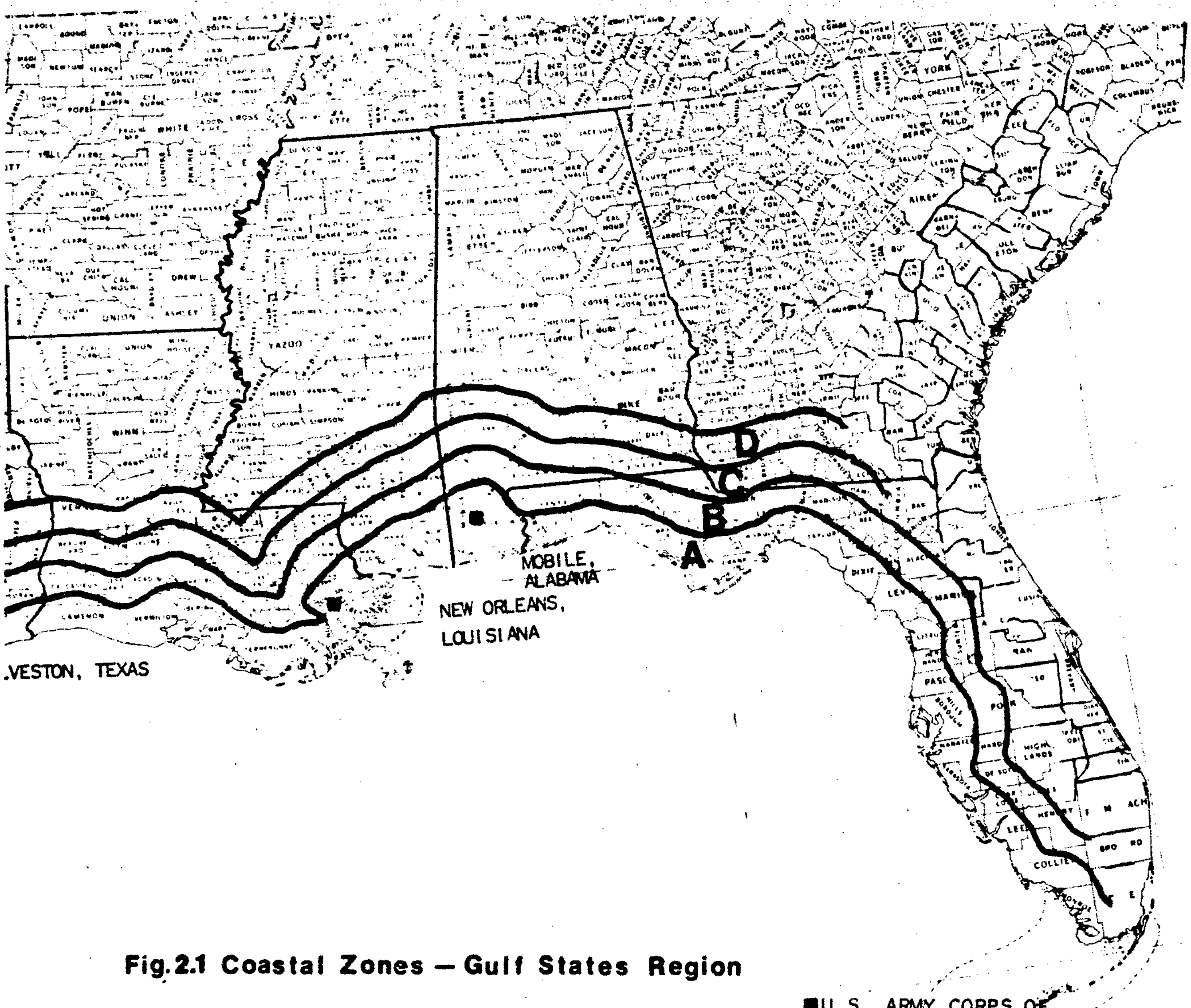


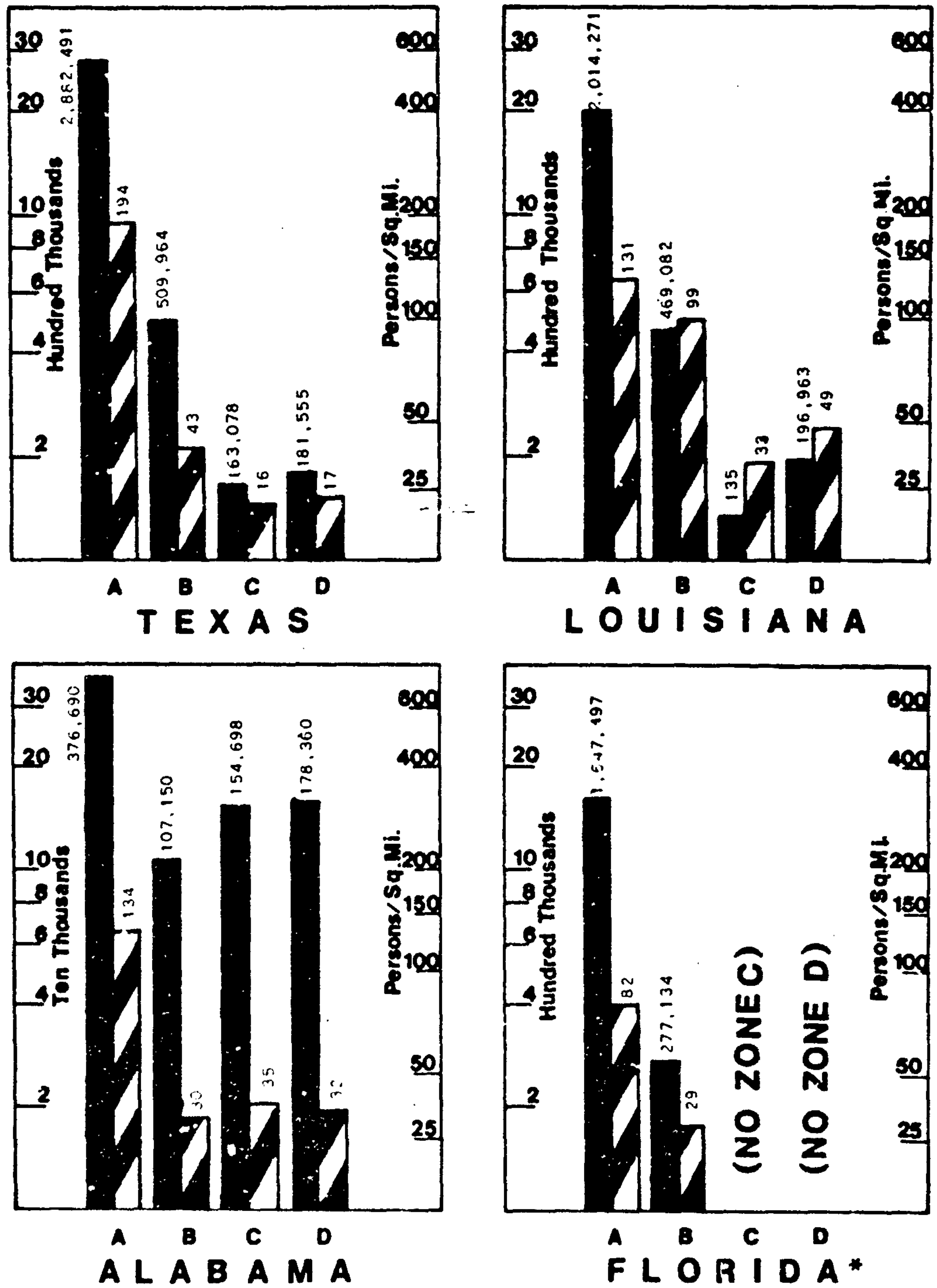
Fig. 2.1 Coastal Zones — Gulf States Region

SCALE 1:7,500,000

■ U.S. ARMY CORPS OF ENGINEERS DISTRICT OFFICE CITIES

30°

85°



*Western Counties LEGEND: Population Density

Fig.2.2 Population and Density by Coastal Zone — Gulf Coast, Tex., La., Ala., Fla.

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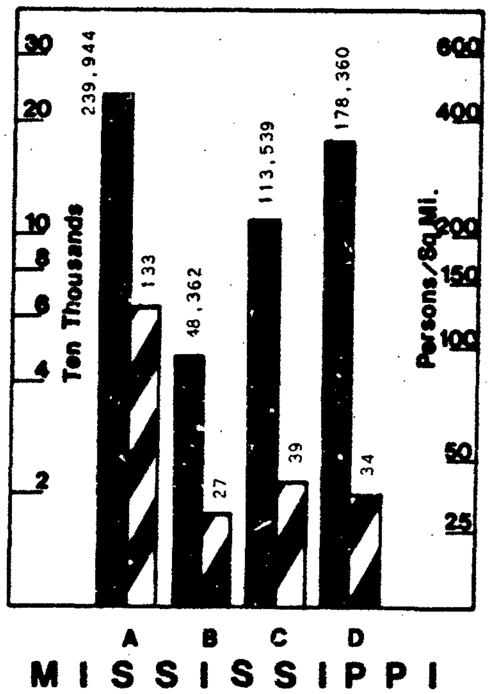


LEGEND: Population . Density

Fig.2.3 Population and Density by Coastal Zone — Gulf Coast, Miss.

General Economic Profile

44. Some pertinent economic factors can be read at a glance from Table 2.1. Employment, median family income, extent of manufacturing, sales, agriculture and mineral production can be compared between the several Gulf area states. These data reflect the level of urban and economic development attained in each state. It is possible to improve a low economic profile by increasing the developable land base for economic uses. Dredged material can become a useful resource for these purposes particularly in the states of Mississippi, Alabama and Louisiana.

45. Food products, chemicals, petroleum, paper and transportation equipment dominate the overall economic picture. With strong indications of continued growth in the warm climate states and with increasing demands for petroleum products, present Gulf States industries must expand. As our demands for oil continue to exceed our local supplies, pressure to develop offshore oil resources will mount. Improved techniques in producing these resources should receive public acceptance.

46. Agriculture. Cotton is one of this Region's most economically important products. Other important products include rice, sweet potatoes, sugar cane, pecans, soybeans, corn, vegetables, and livestock.

47. Tourism. The warm winter climate of the Gulf States is a significant tourist attraction which adds to the regional economy. Both Texas and Florida dominate in the dollar amount received per annum from out-of-state tourism.

Transportation

48. The transportation mix found in the Gulf region is both varied and extensive. A full range of facilities exist in the form of highway, rail, air and water. The backbone of the region is Interstate 10. This limited access highway links every major city between San Antonio, Texas and Jacksonville, Florida to the entire national system of interstate highways. Other interstate highways link each port city to this system. Excellent rail facilities extend from the principal cities providing 4 day service to more than half of the deepwater ports; the Gulf region has the most accessible water transportation system in the U.S. The entire middle of the nation as well as the eastern seaboard is linked to the Gulf

by this waterway network. Every port city has its own airport with major airport facilities located at Houston, New Orleans, and Mobile providing jet and international service.

Existing Development Trends.

49. The existing development trends are consistant with the central city pattern established along the coast. These patterns are represented as concentrated urban centers adjacent to the coastline with new growth expanding inland along primary highway corridors. It is expected that these patterns will continue in this manner with increased urban development filling the spaces between radial highway expansions. There are 9 coastal and 5 inland cities of sufficient size with their respective counties to qualify as Standard Metropolitan Statistical Areas (SMSA). An SMSA involves a central city area and county of specified population, urban character and concentration. (See Plate 7) The Gulf States region contains 14 SMSA's within the 100 mile inland range set for the purpose of this study. While only one SMSA lost population one-haif of them actually lost population as a result of out-migration. This condition occurs where more people move out of an area than those who move in. The growth shown is a result of natural increase where more births than deaths occured. An interpretation of these data indicates that growth and development will continue but at a modified rate in most coastal city areas. Selectivity of location by in-coming residents (migration) is apparent in that specific areas show substantial growth. Houston and Tallahasee are examples. The Tampa-St. Petersburg area reflects a continued trend toward attracting an older "retired" population group. This situation will change as industrial shifts and movements to warm climate regions continue in the future.

Availability of Dredged Material.

Supply.

50. Quantity. The combined volume of material dredged annually by the three Corps Districts in the Gulf States region amounts to 138 million cubic yards. The annual material supply is a result of maintenance project work conducted in the various harbors, entrance channels and intercoastal waterway. The New Orleans District produces the largest

quantity as noted in Table 2.2. In addition, it is anticipated that 159 million cubic yards will be dredged from new project work. The greatest amount of this new work will be generated in the Galveston District. New work projects are conducted on a one time basis with some portions added to the annual maintenance program. Annual supply of material, therefore, will approximate 130 to 200 million cubic yards.

51. Source of Material. From table 2.3 it can be seen that the bulk of material supply comes from the ship channels and Gulf Intercoastal Waterway (GIWW). These quantities vary within each District. The New Orleans District material primary source is the Gulf Intercoastal Waterway and the Mississippi River channels while the Mobile Bay channels provide the bulk source in the Mobile District.

52. Quality. Material quality is dependent on the source of the dredging. Maintenance projects produce fine-grained materials in the form of silt, clay and silty sand mixtures. Usually, the better quality material is dredged from rivers and channels where sands and gravels are generally found. New work projects containing undisturbed soils generally produce good quality material. Table 2.4 summarizes the general quality of dredged material. Silt and sand mixtures are most often found with mud, clays and silts also prominently produced.

Demand.

53. Awareness of availability. The awareness of dredged material availability decreases as the distance from the coast increases. Regional planning agencies and other long-range planning groups do not usually consider the use of dredged material as a material resource. Other agencies, such as port authorities, chambers of commerce, and local planning bodies in or near the coastal cities are most aware of this material and take its use into account as a developmental resource. Not all agencies, however, were aware that use of these materials was possible.

54. General requests for material. Periodic requests for the use of dredged material are reviewed by each of the Corps District Offices. The requirements for obtaining permits, financing the building of dikes and preparation of environmental impact statements

usually deter demand. In most requests, the projects are too small for any active concern by the Corps; therefore, they are not accommodated. Because of the complications preliminary to the utilization of dredged material and often the small size of the project, each of the three Districts serving the Gulf States region discourage general use of dredged material for development purposes. Also some concern is expressed that lands created will become economic gains for their private sponsors which may put the Corps in a position to be criticized. Some private users of dredgings as a landfill material have expressed negative opinions on its value. The dewatering time necessary before productive use can be made of created real estate adds to its cost which may be too high to realize an effective return on the initial investment. Such an experience was referenced to a large industrial park site in the Houston Port area.

Limitations affecting use of dredged material.

55. Economics. Overall costs associated with delivery of dredged material to a site of potential use were a frequently mentioned concern. Some agencies contacted felt that costs should be minimal to none since the primary objective of disposal would be achieved upon delivery of the material to an interested party. Others would be willing to pay a comparable price if material received were comparable to that being received from other sources. The question of economics of dredged material utilization is closely tied to a feasible system of transportation. In the Gulf States Region the feasilibility of pipeline transportation is greater than in many other areas of the nation. The low, flat terrain and high potential for beneficial usage in the immediate coastal area create a viable situation for pipeline transportation.

56. Quality. The key resisting factor affecting ready response toward the use of dredged material is its quality. Most agencies referred to dredged material as being polluted, wet, possessing harmful chemicals and something similar to solid wastes rendering its use undesirable. A means to treat dredged material and finding an economical dewatering process would open markets for the material. As indicated in Table 2.4, most material from the Gulf States Region is fine-grained.

57. Environmental contraints. Resistance to dredging operations and subsequent disposal practices, from environmental groups and official agencies has made it necessary to explore new techniques to resolve the problems of turbidity, unsettled suspension, open water disposal, etc. Upland disposal has met with similar resistance from environmentalists as a means to halt disposal on marsh areas and other commonly employed practices.

58. Confined disposal within diked areas provides an upland technique with out similar problems. One of these objections is that the water runoff from confined disposal sites raises turbidity in the receiving waters and may be a contributing factor to increasing pollutants. A suggested solution is to treat the effluent to minimize these problems.

59. Environmental concerns appear at times to be more excessive than necessary and the agencies performing the dredging work often react too sharply without making reasonable attempts to ameliorate given situations. The need to prepare environmental impact statements on the effects of a given project to the environment is a positive step to achieve a reasonable review of the impact, prior to approving a work project. However, similar attempts to study overall effects on marshlands, marine nursery beds, etc., as well as gaining knowledge in the amount of coastal area needed for preservation in order to sustain ecological balance is also needed. Many port areas and harbors will suffer severe economic setbacks for lack of finding suitable disposal areas. By permitting artificial island development in key harbor cities; such as, Blakeley-Pinto Islands in Mobile's Polecat Bay, Pelican Island in Galveston's harbor and the new Centroport in New Orleans, can become significant benefits to an area's economy. The extent of ecological loss to the environment by the development of such lands should be observed.

Regional Landfills

Sampling of landfill projects

60. The vast extent of low lying land and marsh area found in the Gulf States region invites an almost limitless need for fill material. Practically every major new land development with 25 miles of the coastline requires some quantity of fill material. The source of this material is variable with dredged material used extensively for projects where it is readily accessible.

61. A general inventory made in the focal cities of Galveston, New Orleans, Gulfport and Mobile revealed several multiple land use examples employing dredge material as a landfill. The most frequently cited uses are for port and port related facilities and land for industrial use. Along the bays and ship channels wildlife refuges, marine organism nurseries and shellfish beds have developed in a natural manner on emerged and submerged dredged deposits. Beach nourishment projects, park development, levee construction, flood and hurricane control devices are regular applied uses of dredged material. Resource development in the form of artificial islands, sand and gravel extraction activity and mount banks used by grazing cattle are evident results of dredged material deposits. Entire urban developments such as the city of New Orleans are a notable example of dredged material utilization. A variety of existing proposed and potential landfill projects were reported by the contacted regional and state agencies. These various projects are characterized in matrix form according to their primary land development as urban, economic, environmental and resource. Values of 3, 2 and 1 were assigned respectively to project status as existing, proposed and potential respectively. Matrix 2A, Sampling of Landfill Projects, reports the resulting analysis. Tables 2.5 through 2.8 present brief descriptions of projects include in Matrix 2A. It is readily noted that most existing and contemplated uses of fill material are in the first coastal zone. These responses are graphically illustrated in Figure 2.4. Each graph represents an index of use intensity within the range 0 to 3. The value 3 indicates a high degree of use with values in between representing a realtive degree of use intensity. The reference numbers included in Tables 2.5 through 2.8 refer to the source of information as follows:

1. Telephone contact
2. Corps District Office interview
3. Personal visit and discussion at regional agency
4. Letter reply
5. Other published referenced material

MATRIX 2A

SAMPLING OF LANDFILL PROJECTS			USACE DISTRICTS - COASTAL ZONES															
			GALVESTON HOUSTON				NEW ORLEANS				GULFPORT				MOBILE			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	3	1	-	-	3	2	1	1	3	2	-	-	3	1	-	-
		COMMERCIAL	-	1	-	-	3	2	1	1	3	1	-	-	3	1	-	-
		RESORTS: COMMERCIAL CAMPS	3	-	-	-	3	1	1	1	2	1	-	-	3	-	-	-
		COMMUNITY FACILITIES	3	1	-	-	3	2	1	1	1	1	-	-	-	-	-	-
		MEAN	2.5	0.8	—	—	3.0	1.8	1.0	1.0	2.2	1.2	—	—	2.3	0.5	—	—
	ECONOMIC	INDUSTRIAL	3	1	1	1	3	2	1	1	3	2	-	-	3	2	-	-
		RAIL: RAPID TRANSIT	-	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		AIRPORTS	-	-	-	-	3	2	1	-	-	-	-	-	3	-	-	-
		HARBORS: PORTS	3	-	-	-	3	2	-	-	3	-	-	-	3	-	-	-
		HIGHWAYS	3	1	1	1	3	2	1	1	1	1	1	1	3	1	1	1
		UTILITIES	-	-	-	-	3	-	-	-	-	-	-	-	3	-	-	-
		MEAN	1.5	0.3	0.3	0.3	3.0	1.3	0.5	0.3	1.7	0.5	0.2	0.2	3.0	0.5	0.2	0.2
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	3	-	-	-	3	1	1	1	3	-	-	-	3	-	-	-
		MARINE NURSERIES	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
		BEACH NOURISHMENT	3	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
		PARKS & RECREATION: PUBLIC	3	1	1	1	3	2	-	-	2	1	-	-	3	1	1	1
		MARSHLAND MANAGEMENT	3	1	-	-	3	-	-	-	2	-	-	-	3	-	-	-
		SANITARY LANDFILLS	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1
		OTHER LANDFILLS	1	1	1	1	1	1	1	1	1	1	1	1	-	1	1	1
		FLOOD PLAIN CONTROLS/LEVEES	3	1	-	-	3	3	2	1	3	1	-	-	3	1	-	-
		MEAN	2.5	0.6	0.4	0.4	1.9	1.1	0.8	0.6	1.9	0.5	0.3	0.3	2.4	0.5	0.4	0.4
	RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		AGRICULTURAL/GRAZING LAND	3	1	1	1	-	3	1	-	2	1	-	-	-	-	-	-
		FORESTRY	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
		BRICK MFG.: CERAMICS, ETC.	1	-	-	-	-	-	-	-	3	1	1	1	-	-	-	-
		LAND RECLAMATION	1	1	-	-	3	2	1	1	-	-	-	-	3	1	-	-
		SAND & GRAVEL	-	-	-	-	3	1	-	-	1	-	-	-	3	-	-	-
		MATERIAL STOCKPILES	3	1	1	1	2	2	1	1	1	-	-	-	-	1	-	-
		MEAN	1.6	1.0	0.3	0.3	1.6	1.5	1.4	0.3	1.4	0.6	0.1	0.1	1.3	0.3	—	—
		MEAN VALUES	2.0	0.5	0.3	0.3	2.2	1.4	0.6	0.5	1.8	0.6	0.2	0.2	2.2	0.4	0.2	0.2

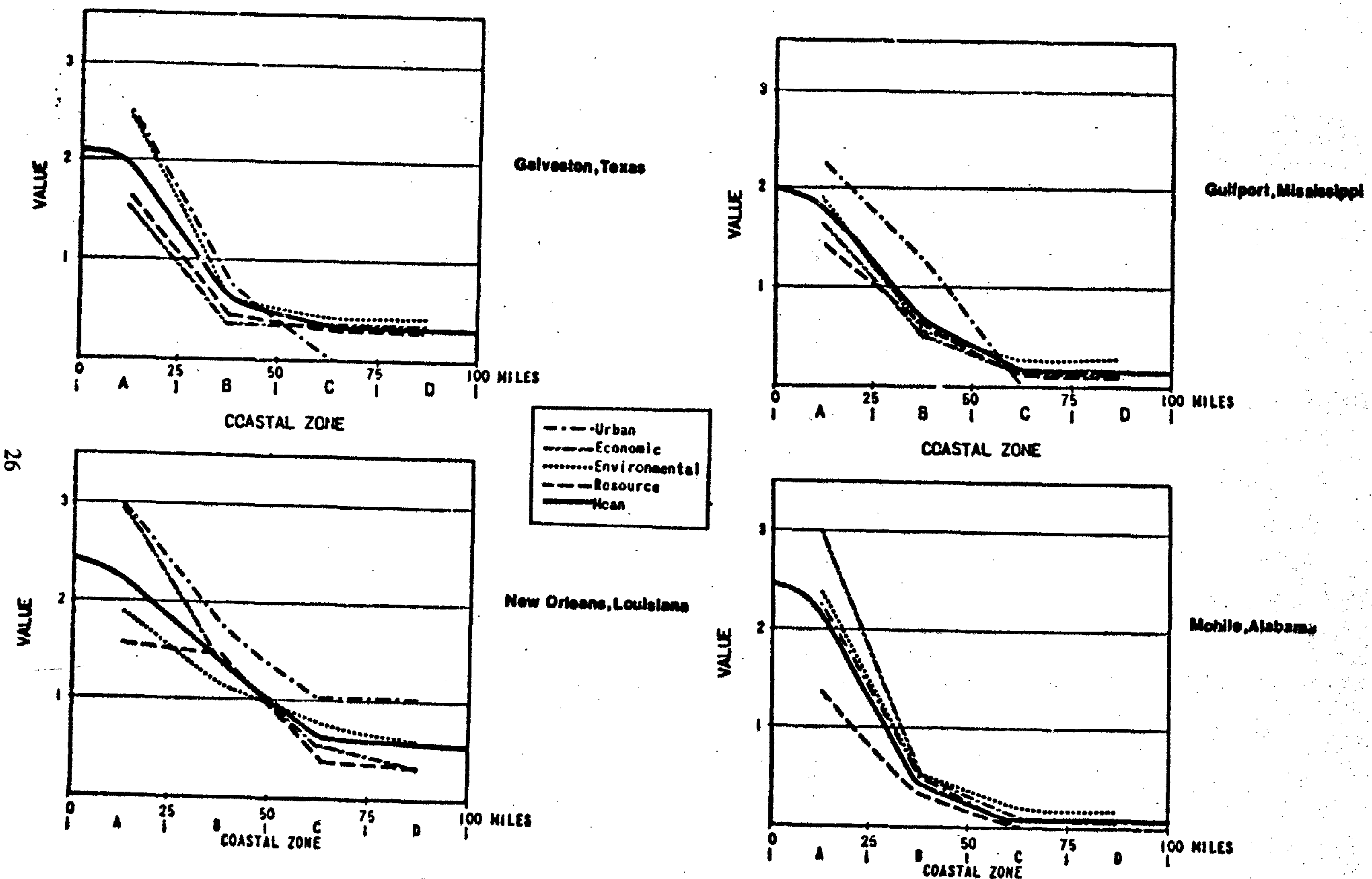


Fig. 2.4 Existing Landfill Projects
MATRIX 2A

Example Projects

62. Notable example projects utilizing dredged material as a resource base for land use developments are found in each of the focal city areas. Of particular interest is the new town-in-town concept being advanced within the corporate limits of New Orleans. This new urban development known as "Pontchartrain and Lake Borgne.[2.11.] Housing, commerce and industrial space is allocated amidst parks, lakes and conservation areas (see Plate 8). The site consists of low lying marshland and deltaic deposits which will require either the pumping of water from lakes and canals to maintain depressed levels, or a second and more favorable alternative, a large-scale fill placement to raise the general site grade. The fill would be pumped to the site from the source. Buried ancient beach sand deposits have been found nearby. A levee system is being upgraded by the Corps of Engineers and the Orleans Levee Board to protect this area against a possible 200 year frequency hurricane storm and flood. The Port of New Orleans is being relocated from its Mississippi River location to the Mississippi River - Gulf Outlet. This new "Centroport" is situated between the Inner Harbor Navigation Canal and the Michoud Canal. The new facility is designed to meet advanced shipping and terminal needs. Adjacent land area with access to the shipping channel will be made available for private industrial development. The material obtained by dredging to enlarge the ship channels, access canals and turning basin will be used to create the land base for port development. Figure 2.5 illustrates the recommended long-range master plan for the Port.

63. An Interim Development Plan for Battleship Parkway across the northern tip of Mobile Bay in Alabama proposes the blending of public and commercial resort facilities. The land base supporting much of the existing development was created with dredged material. Future land expansion to develop the recommended facilities will require additional landfill. Figure 2.6 shows Mobile's Battleship Park and an adjacent marina and motel proposal off Interstate Route 10.[2.12.]

64. Industrial site development adjacent to the port cities frequently employs dredged material as a principal landfill source. A typical industrial park development

planned along the Mobile River near the Alabama State Docks is shown on Figure 2.7. This site was upgraded in value by filling with dredged material. The land was recently appraised at 750 to 800 dollars per acre. [2.11] Near Baton Rouge, Louisiana, a section of Interstate 10 was constructed through a low lying swamp area on an embankment of sand, shell and gravel pumped from the Mississippi River. The embankment material was placed at an average depth of 18 feet. [2.12]

65. With the advent of super oil tankers, the planning for future development of "Super Ports" is progressing. Advanced proposals for a superport offshore from New Orleans, [2.6] and an Ameraport off Pascagoula, Mississippi and Mobile, Alabama [2.6] have been made. A superport facility will add a significant economic impact to its adjacent shore area with new jobs, income and increased capacity for refining oil. Industrial land development on adjacent shores for tank farms, new refineries and petro-chemical industries will increase. Landfill will be needed in great quantities to accommodate this new development. Figure 2 8 shows a proposed location pattern in the Gulf of Mexico for super tanker mooring and coastal support facilities.

Potential Landfill Projects.

66. Value judgements concerning growth trends, land developments and physical land forms were related to the responses received from the Gulf States agencies and recorded on a landfill potential matrix (Matrix 2B). This matrix reflects a higher level of need for landfills within the first coastal zone and substantial potential within the second coastal zone. Thereafter, the use potential decreases primarily due to a decrease in development and population density within zones C and D. The high potential need in the first zone is due to the low lying physical characteristics of the coastal region. Fill materials most frequently are needed to develop any land use activity on the low elevation and marshes.

67. Figure 2.9 gives a graphic description of landfill potential. These graphs readily show the apparent high potential need for fill when compared to Figure 2.4, Existing Landfill Projects. Differences also are evident between the focal cities studied. It is of interest to note that the most frequently referenced proposal or potential use

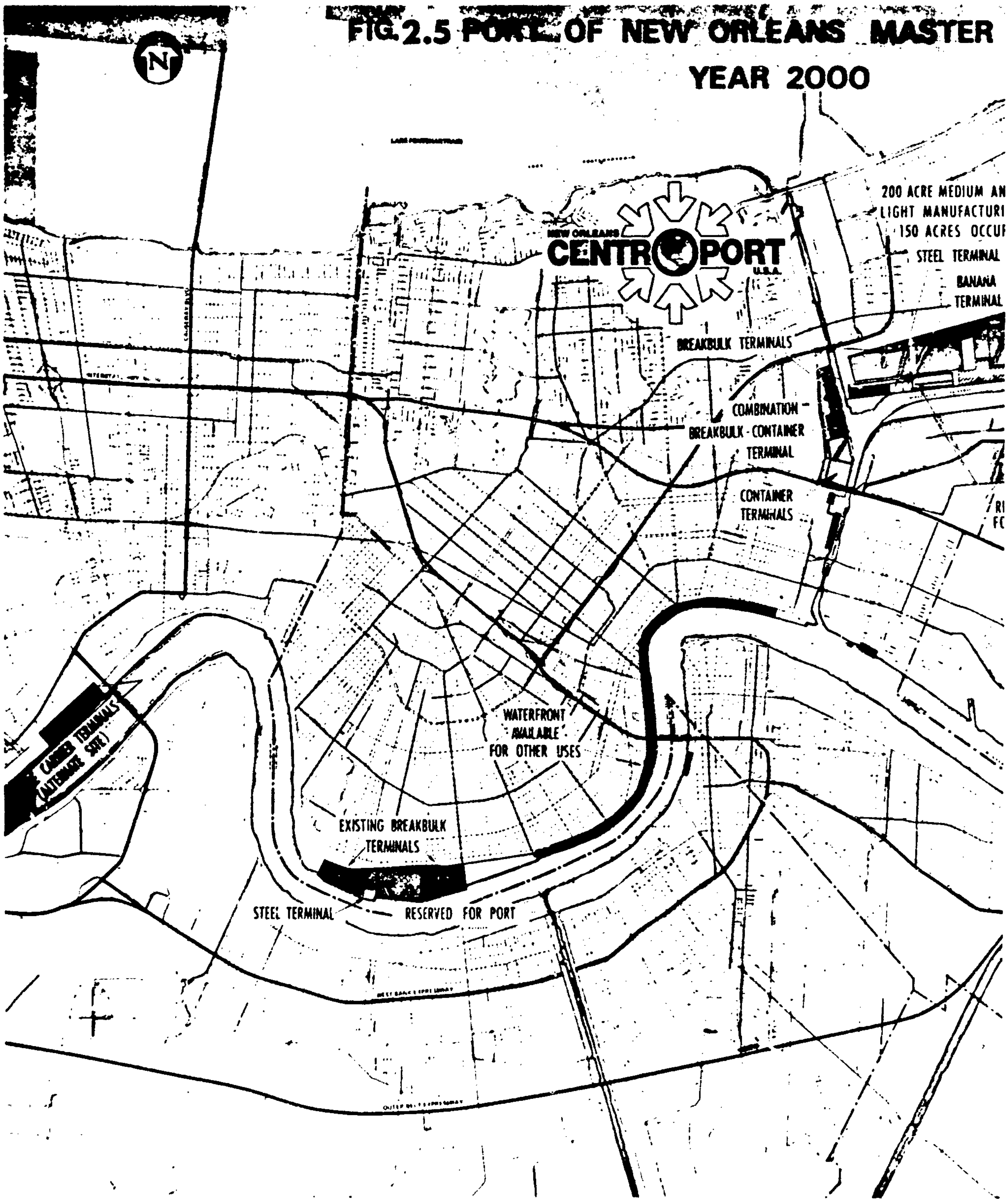
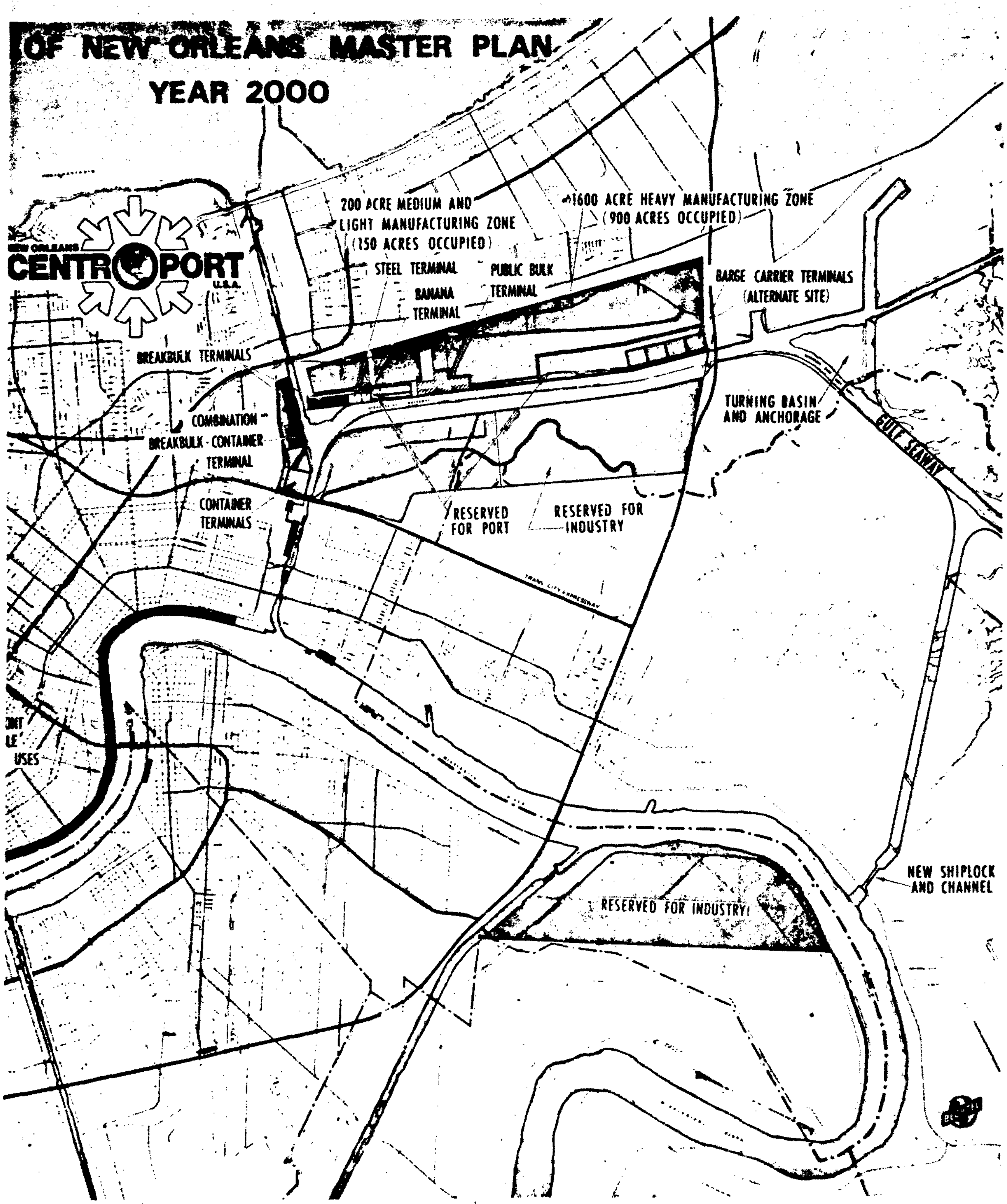
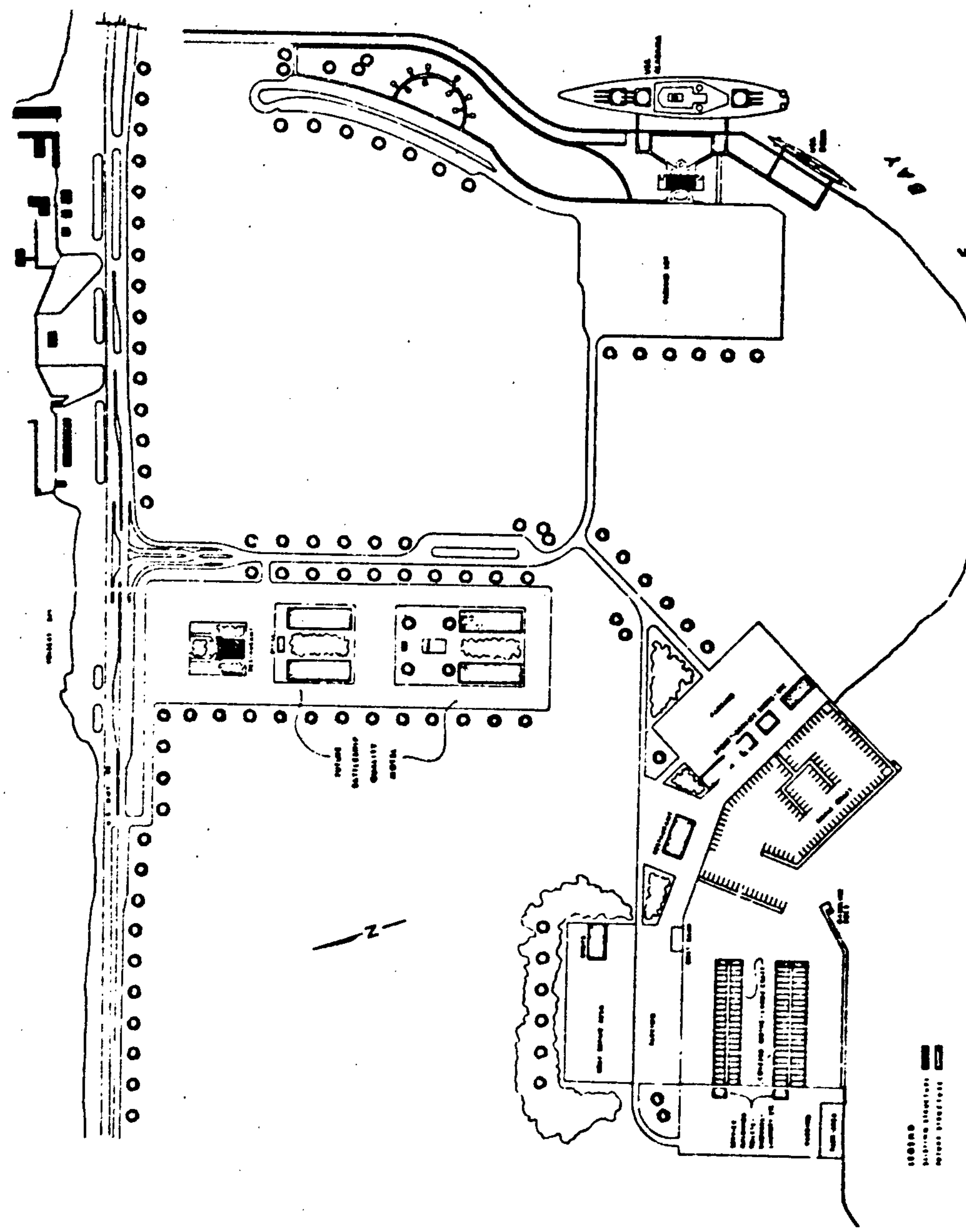


FIG. 2.5 PORT OF NEW ORLEANS MASTER
YEAR 2000
NEW ORLEANS CENTROPORT U.S.A.
200 ACRE MEDIUM AN
LIGHT MANUFACTURI
150 ACRES OCCUI
STEEL TERMINAL
BANANA TERMINAL
BREAKBULK TERMINALS
COMBINATION BREAKBULK-CONTAINER TERMINAL
CONTAINER TERMINALS
WATERFRONT AVAILABLE FOR OTHER USES
EXISTING BREAKBULK TERMINALS
STEEL TERMINAL
RESERVED FOR PORT
CARRIER TERMINALS (ALTERNATE SITE)


OF NEW ORLEANS MASTER PLAN
YEAR 2000
NEW ORLEANS
CENTROPORT
U.S.A.
200 ACRE MEDIUM AND
LIGHT MANUFACTURING ZONE
(150 ACRES OCCUPIED)
1600 ACRE HEAVY MANUFACTURING ZONE
(900 ACRES OCCUPIED)
STEEL TERMINAL
PUBLIC BULK
TERMINAL
BANANA
TERMINAL
BARGE CARRIER TERMINALS
(ALTERNATE SITE)
BREAKBULK TERMINALS
COMBINATION
BREAKBULK - CONTAINER
TERMINAL
TURNING BASIN
AND ANCHORAGE
GULF SEAWAY
CONTAINER
TERMINALS
RESERVED
FOR PORT
RESERVED FOR
INDUSTRY
USES
NEW SHIPLOCK
AND CHANNEL
RESERVED FOR INDUSTRY



PROPOSED
BATTLESHIP PARK MARINA & MOTEL

Fig.2.6

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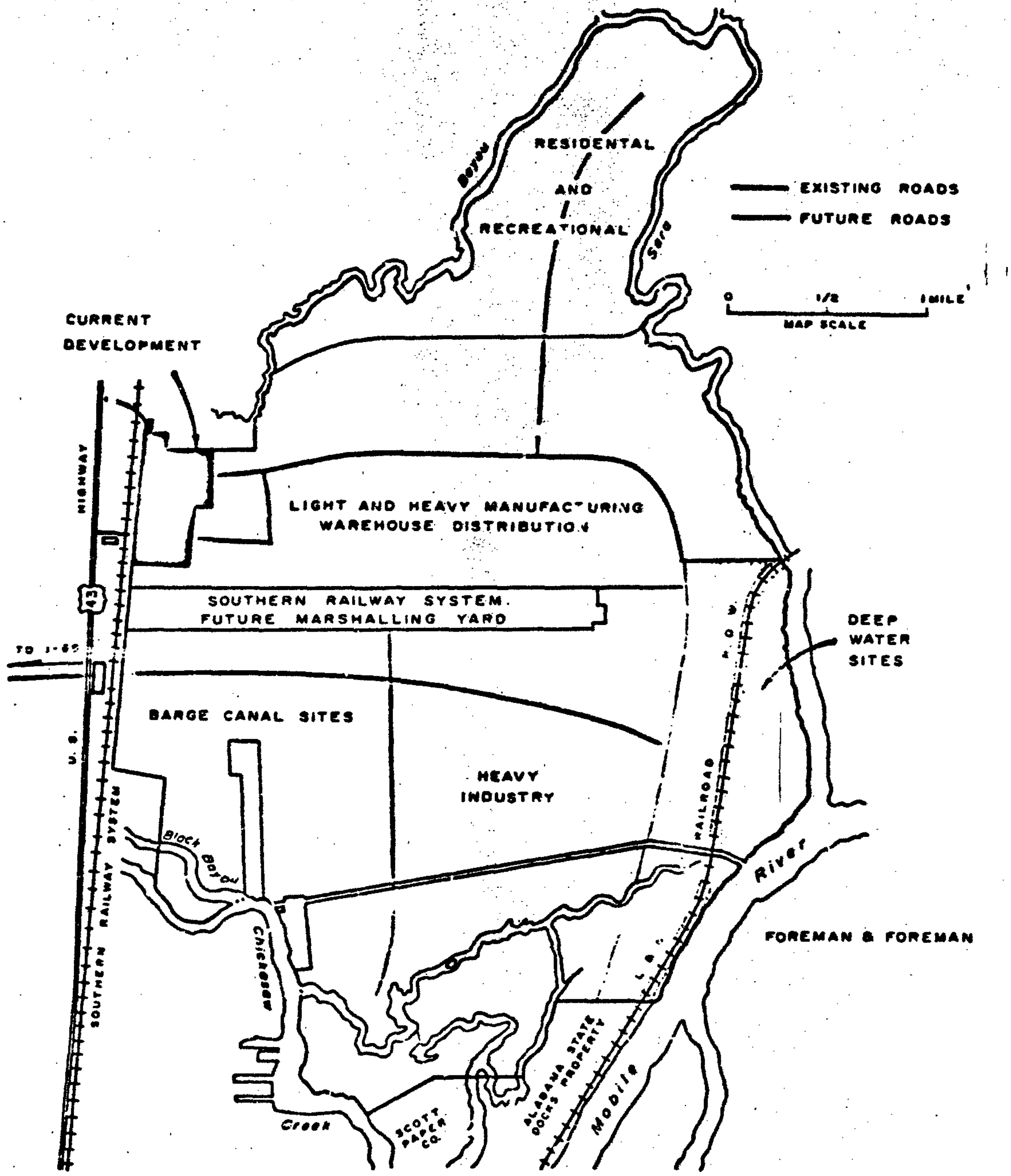


JACINTOPORT MOBILE PROPERTY

7100 ACRES WITHIN THE CITY LIMITS OF MOBILE

Fig.2.7

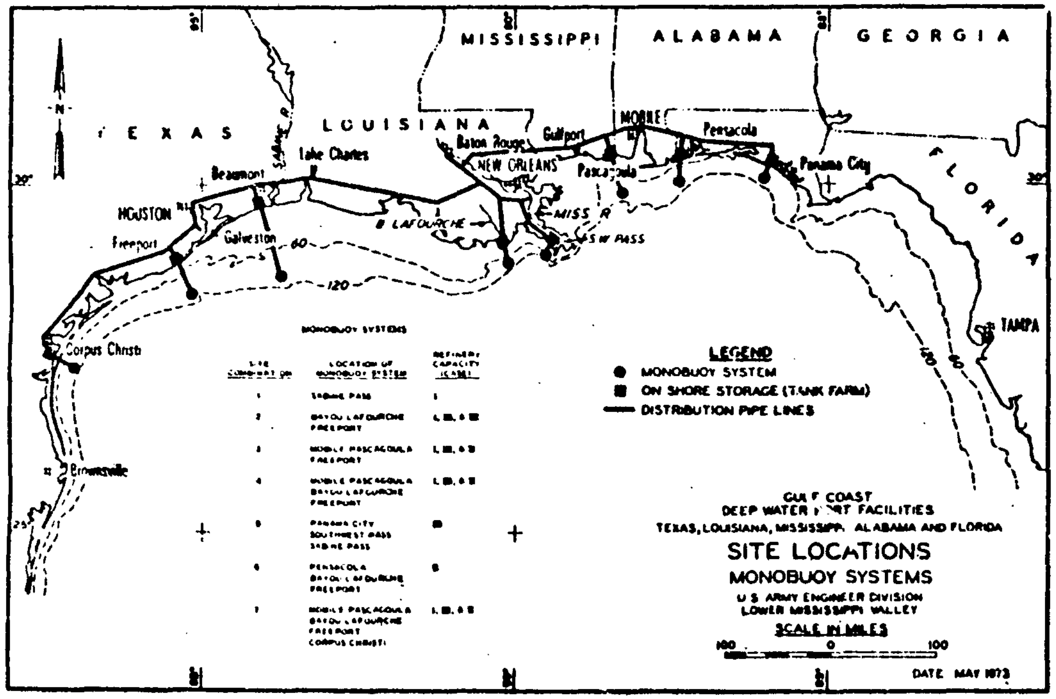


Fig.2.6 Offshore Port Facilities

MATRIX 2B

POTENTIAL LANDFILL PROJECTS			USACE DISTRICTS - COASTAL ZONES															
			GALVESTON HOUSTON				NEW ORLEANS				GULFPORT				MOBILE			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	3	2	1	2	3	3	3	2	3	2	1	-	3	1	-	-
		COMMERCIAL	3	2	1	2	3	3	3	2	3	2	1	-	3	1	-	-
		RESORTS: COMMERCIAL CAMPS	3	-	-	-	3	3	2	1	3	1	-	-	3	1	-	-
		COMMUNITY FACILITIES	3	1	-	-	3	3	3	2	2	2	1	-	3	1	-	-
		MEAN	3.0	1.3	0.5	1.0	3.0	3.0	2.8	1.8	3.0	1.8	0.3	—	3.0	1.0	—	—
	ECONOMIC	INDUSTRIAL	3	2	-	1	3	3	2	1	3	1	-	-	3	2	1	-
		RAIL; RAPID TRANSIT	3	2	-	-	3	3	2	1	2	-	-	-	3	2	-	-
		AIRPORTS	3	3	2	1	3	3	3	1	3	2	-	-	3	-	-	-
		HARBORS: PORTS	3	-	-	-	3	3	2	-	3	-	-	-	3	-	-	-
		HIGHWAYS	3	2	1	2	3	3	3	2	3	2	1	-	3	2	2	1
		UTILITIES.	3	1	1	2	3	3	2	2	3	1	-	-	3	2	-	-
		MEAN	3.0	1.7	0.5	1.0	3.0	3.0	2.3	1.2	2.8	1.0	0.2	—	3.0	1.7	0.5	0.2
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	3	2	-	-	3	3	2	-	3	3	2	-	3	2	1	-
		MARINE NURSERIES	3	-	-	-	3	3	3	-	3	3	1	-	3	3	1	-
		BEACH NOURISHMENT	3	-	-	-	2	1	-	-	3	1	-	-	2	-	-	-
		PARKS & RECREATION: PUBLIC	3	3	2	1	3	3	2	1	3	3	2	1	3	2	1	1
		MARSHLAND MANAGEMENT	3	2	-	-	3	3	3	2	3	3	-	-	3	2	2	-
		SANITARY LANDFILLS	3	2	1	2	3	3	3	3	3	2	2	1	3	2	1	1
		OTHER LANDFILLS	2	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2
		FLOOD PLAIN CONTROLS/LEVEES	3	2	-	-	3	3	3	3	3	3	2	1	3	2	2	1
		MEAN	2.8	1.6	0.6	0.6	2.8	2.5	2.1	1.3	2.8	2.4	1.3	0.5	[illegible]	1.0	1.3	0.5
	RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	3	2	2	-	3	-	-	-	3	-	-	-
		AGRICULTURAL/GRAZING LAND	3	3	2	1	3	3	3	3	3	3	2	1	3	2	1	-
		FORESTRY	3	2	2	3	3	2	2	2	3	3	2	3	2	3	3	2
		BRICK MFG.: CERAMICS, ETC.	3	-	-	-	3	2	2	2	2	-	-	[illegible]	3	2	-	-
		LAND RECLAMATION	3	-	-	-	3	3	3	2	2	3	2	2	3	2	2	1
		SAND & GRAVEL	3	2	-	-	3	3	3	3	3	2	-	-	3	2	-	-
		MATERIAL STOCKPILES	3	1	2	3	3	3	3	3	3	3	2	1	3	3	2	1
		MEAN	3.0	1.1	0.9	1.5	3.0	2.6	2.6	2.1	2.9	2.0	1.1	0.7	[illegible]	2.0	0.9	0.6
		MEAN VALUES	3.0	1.9	0.7	0.9	2.9	2.7	2.1	1.6	2.8	1.8	0.9	0.4	2.3	1.7	0.8	0.4

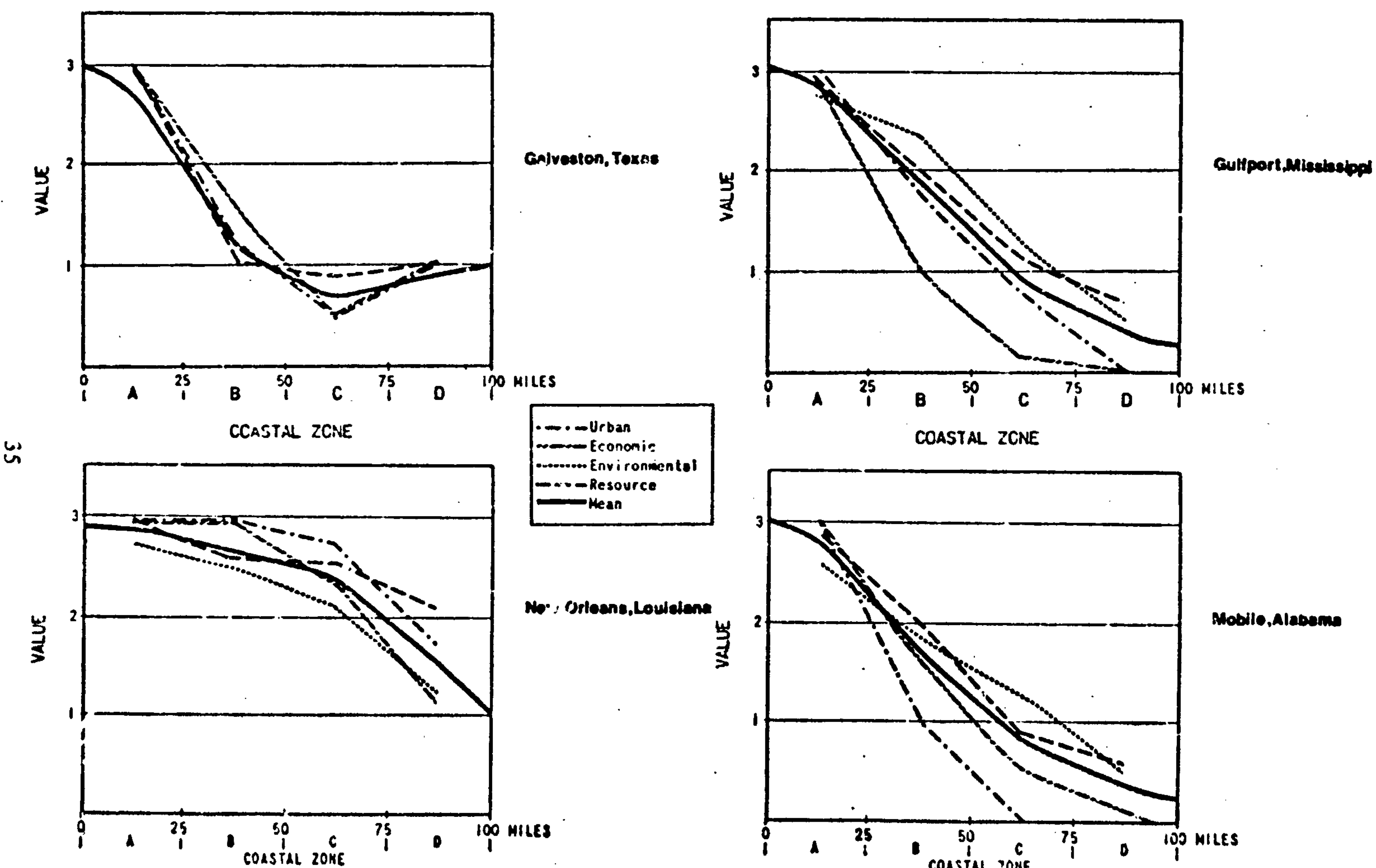


Fig. 2.9 Potential Landfill Projects

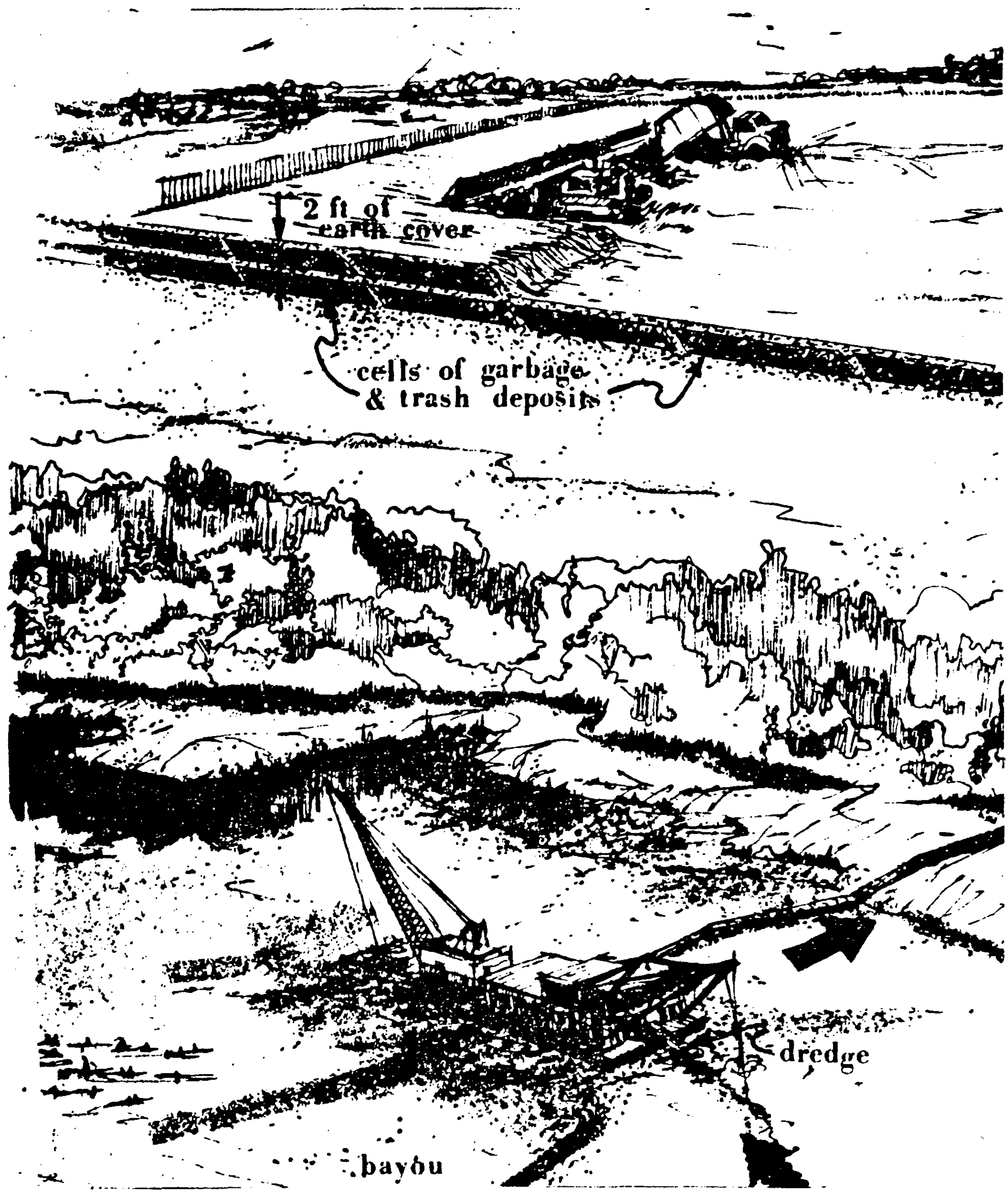
MATRIX 2B

recommendation for dredgings was as sanitary landfill cover material. One example was submitted by an engineering firm in Baton Rouge. The firm is seeking a demonstration grant to develop a sanitary landfill project utilizing material dredged from adjacent rivers and bayous. Figure 2.10 shows a rendering of this proposal which employs the use of hydraulic fill pumped to a stockpile site and eventually used for cover material. It should be pointed out that in actual practice the stockpiled material would be contained within a levee or impounding dike. Water runoff from the material could be placed in a retention pond or sewage lagoon prior to return to the bayou. Most respondants in the Gulf region looked to dredged material for sanitary landfill cover because other suitable material has to be brought into the area and therefore represents a high continued cost.

68. Other potential uses cited by some regional agencies were in marshland management for the construction of berms to prevent beach erosion and reclaiming inundated marshland in a balanced manner so as not to disrupt the eco-cycle. Another unique suggestion made in one Mississippi area was to use dredgings as a means to "purify" established lake bottoms. By dumping the material onto lake bottoms it would cover the existing bottom soil now contaminated with pesticides from adjacent agricultural land. This plan is expected to prevent lake fish from feeding on the pesticides now present. Marshland stabilization by experimenting with growing salt grasses on dredged fills is currently being conducted in Texas. Seeding by spraying seed from low flying aircraft is also being tried.

Assessment of potentials and needs

69. It follows from the analysis of existing landfill projects (Matrix 2A) and landfill potential (Matrix 2B) that a level of material quantity can be determined. In areas of use experience and high potential, a relative high degree of demand and/or need is assumed to exist. To establish this relationship in graphic form a matrix on quantitative assessment (Matrix 2C) was prepared to show these needs by coastal zone. From Figure 2.11 it can be seen that in each of the focus cities Zone A requires the greatest amount of fill material. Demand drops sharply in Zone B and steadily drops as the distance from the coast increases. The New Orelans area shows up as having the greatest fill requirement.


2 ft of
earth cover
cells of garbage
& trash deposits
dredge
bayou

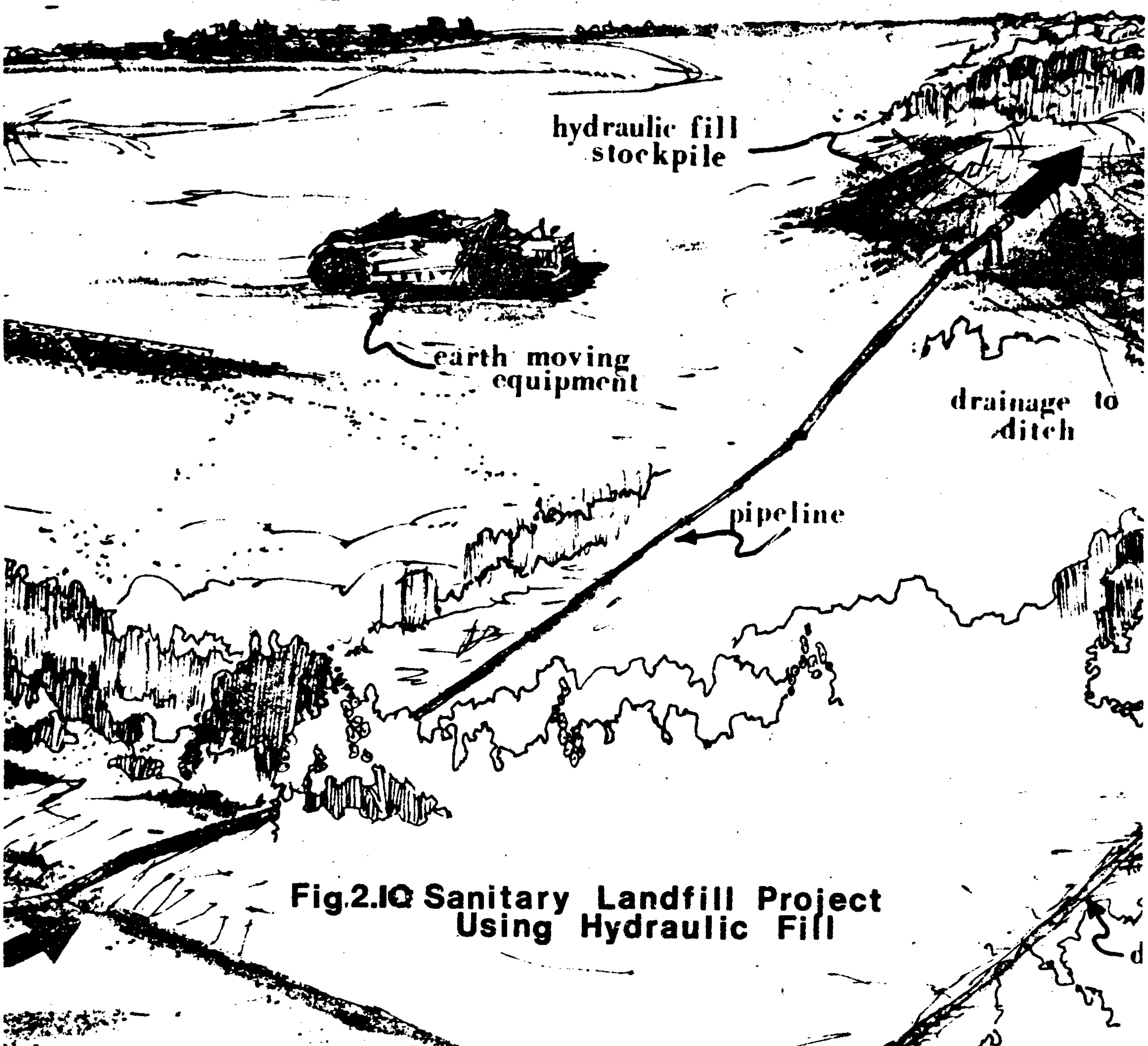
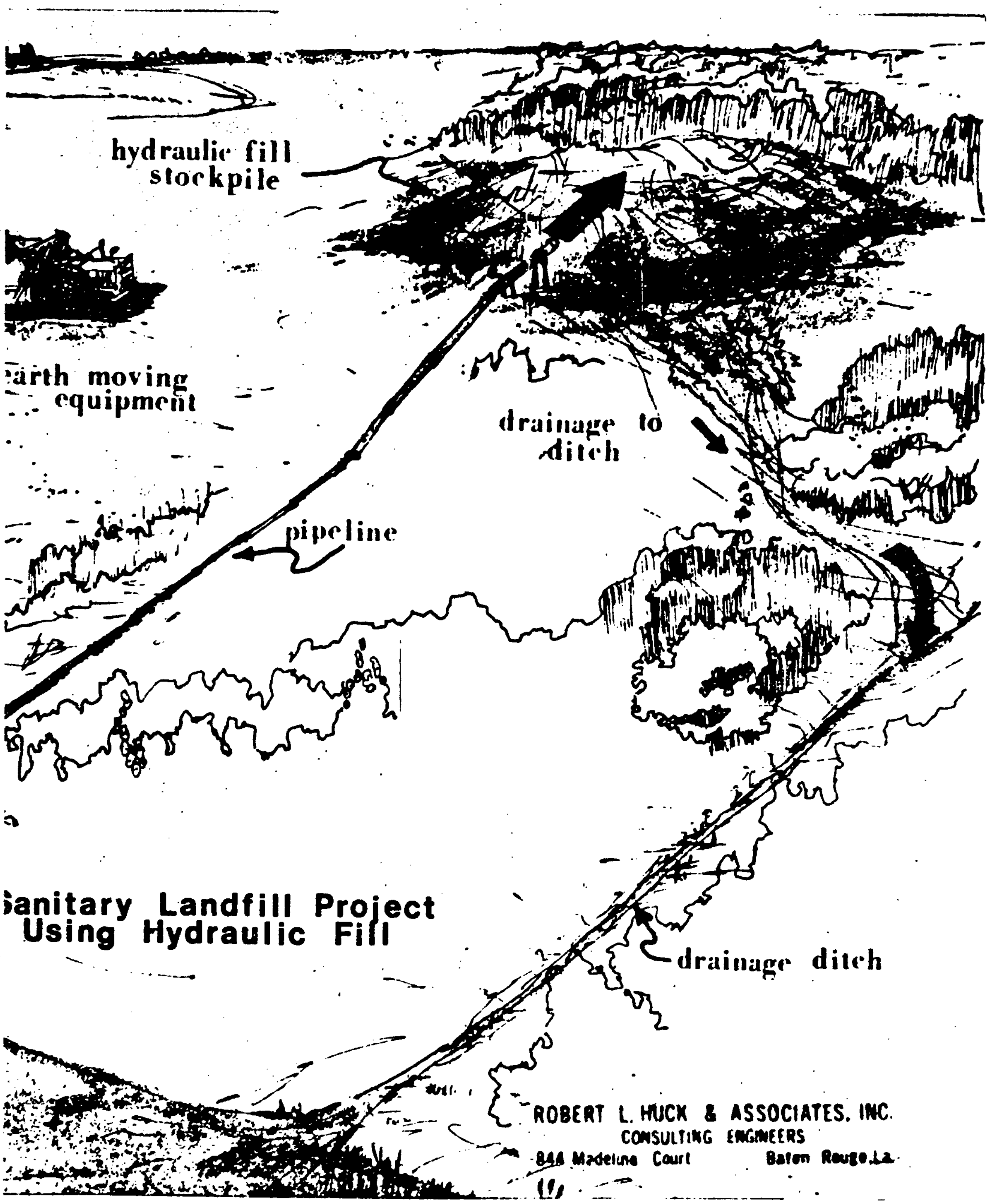


Fig.2.IQ Sanitary Landfill Project
Using Hydraulic Fill


hydraulic fill
stockpile
earth moving
equipment
drainage to
ditch
pipeline
Sanitary Landfill Project
Using Hydraulic Fill
drainage ditch
ROBERT L. HUCK & ASSOCIATES, INC.
CONSULTING ENGINEERS
844 Madeline Court Baton Rouge,La.

MATRIX 2C

QUANTITATIVE ASSESSMENT			GALVESTON HOUSTON				NEW ORLEANS				GULFPORT				MOBILE			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	3	1	1	1	3	2	2	1	3	2	1	-	3	1	-	-
		COMMERCIAL	2	1	1	1	3	2	2	1	3	1	1	-	3	1	-	-
		RESORTS; COMMERCIAL CAMPS	3	-	-	-	3	2	1	1	2	1	-	-	3	1	-	-
		COMMUNITY FACILITIES	3	1	-	-	3	2	2	1	2	1	1	-	1	1	-	-
		MEAN	2.8	0.8	0.5	0.5	3.0	2.0	1.8	1.0	2.5	1.3	0.8	—	2.5	1.0	—	—
	ECONOMIC	INDUSTRIAL	3	1	1	1	3	2	1	1	3	1	-	-	3	2	1	-
		RAIL; RAPID TRANSIT	1	1	-	-	3	1	1	1	2	-	-	-	3	1	-	-
		AIRPORTS	1	1	1	1	3	2	2	1	1	1	-	-	3	1	1	-
		HARBORS; PORTS	3	-	-	-	3	2	2	1	1	1	-	-	3	1	1	-
		HIGHWAYS	3	1	1	1	3	2	2	1	2	1	1	1	3	1	1	1
		UTILITIES	1	1	1	1	3	1	1	1	1	1	-	-	3	1	-	-
		MEAN	2.0	0.8	0.7	0.7	3.0	1.7	1.2	0.8	2.0	0.7	0.2	0.2	3.0	1.0	0.5	0.2
	ENVIRONMENTAL	WILDLIFE REFUGES; ROOKERIES	3	1	-	-	3	2	1	1	3	1	1	-	3	1	1	-
		MARINE NURSERIES	3	-	-	-	1	1	1	-	1	1	1	-	3	1	1	-
		BEACH NOURISHMENT	3	-	-	-	1	1	-	-	3	1	-	-	2	-	-	-
		PARKS & RECREATION: PUBLIC	3	2	1	1	3	2	1	1	2	2	1	1	3	1	1	1
		MARSHLAND MANAGEMENT	3	1	-	-	3	1	1	1	2	1	-	-	3	1	1	-
		SANITARY LANDFILLS	2	1	1	1	3	3	3	2	2	1	1	1	2	1	1	1
		OTHER LANDFILLS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		FLOOD PLAIN CONTROLS/LEVEES	3	1	-	-	3	3	2	2	3	2	1	1	3	1	1	1
		MEAN	2.6	0.9	0.4	0.4	2.3	1.8	1.3	1.0	2.1	1.3	0.8	0.5	2.5	0.9	0.9	0.5
	RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	3	1	1	-	3	-	-	-	3	-	-	-
		AGRICULTURAL/GRAZING LAND	3	2	1	1	1	1	2	1	2	2	1	1	1	1	1	-
		FORESTRY	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
		BRICK MFG.; CERAMICS, ETC.	2	-	-	-	1	1	1	1	2	1	1	1	1	1	-	-
		LAND RECLAMATION	3	1	-	-	3	2	2	1	1	1	1	1	3	1	1	1
		SAND & GRAVEL	1	1	-	-	3	3	1	1	2	1	-	-	3	1	-	-
		MATERIAL STOCKPILES	3	1	1	2	2	2	2	2	2	1	1	1	1	2	1	1
		MEAN	2.1	0.9	0.4	0.6	2.0	1.9	1.4	1.0	1.9	1.1	0.7	0.7	1.8	1.0	0.6	0.4
		MEAN VALUES	2.4	0.9	0.5	0.5	2.48	1.8	1.36	.96	2.03	1.08	.60	.40	2.64	.96	.56	.25

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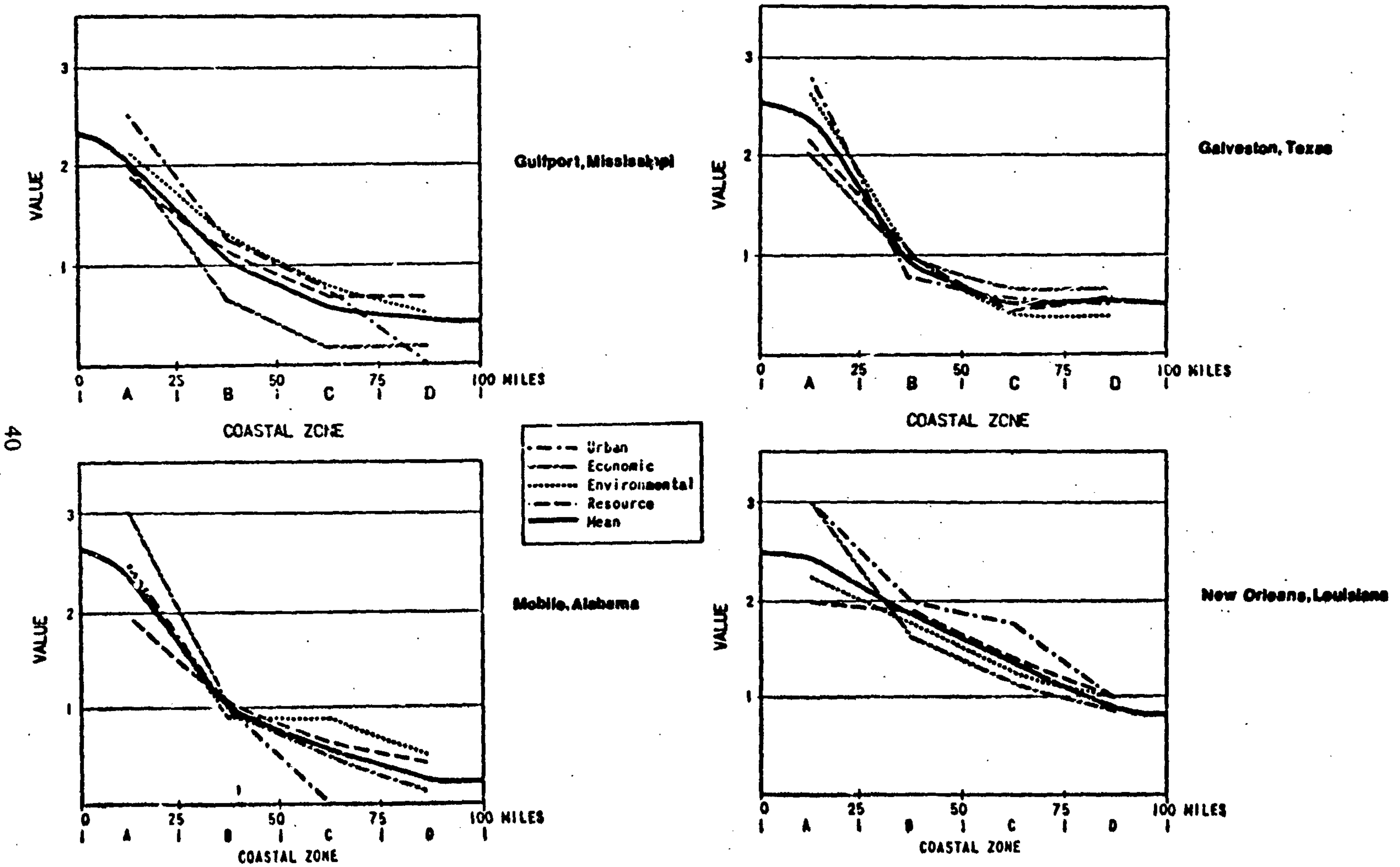


Fig. 2.11 Quantitate Assessment
MATRIX 2C

The matrix values represent a general quantitative assessment as follows:

3 - Over 2,500,000 cubic yards

2 - 500,000 to 2,500,000 cubic yards

1 - Less than 500,000 cubic yards

No attempt was made to differentiate the use of fill for a "one-time" only project or as an annual requirement. In most aspects where fill is needed, the matrix serves to show where the greater needs are most likely to occur. Quantities are not readily known for generally defined needs.

Sample of future land use and development plans

70. To exemplify the relationship of land use planning and the potential utilization of fill materials, the regional plan for the New Orleans area was selected. This regional planning area covers three parishes including Orleans, Jefferson and Saint Bernard, all of which are located in coastal zone A. Most of the land within the region is at or below sea level and contains extensive marsh. Planning considerations to accommodate future population growth and anticipated development have been made by the local planning agencies. A generalized regional development plan is shown on Figure 2.12. Recommended land development on low lying land areas that will require filling have been identified as the colored areas. Significant proposals include the Pontchartrain New Town-In-Town, a new residential community expansion along the southern shore of Lake Pontchartrain, a major new airport location at the eastern edge of Lake Pontchartrain the existing Lake front airport facility in New Orleans at Lake Pontchartrain. These land developments have been classified as urban, economic and environmental as defined earlier. The calculations shown on Figure 2.12 use an average depth of 10 feet. However, subsidence of the foundation material often requires that more hydraulic fill be used.

71. Current dredging operations produce an annual amount of about 35 million cubic yards of a potentially useful silt and sand mixture in the New Orleans District. This would indicate that at an average fill of 10 feet in the designated area, it would take

approximately 19 years to satisfy the requirement. Similar analysis of future land use plans in other planning regions around the Gulf Coast have revealed additional fill requirements needed to accommodate the recommended uses of land. A regional recreation project proposed in Lafayette, Louisiana would need approximately 90 million cubic yards if filled to an average depth of 5 feet. Negotiations with the Corps of Engineers in the New Orleans District were recently requested to investigate the fill possibilities at Lafayette. This project alone would take over 2 years of the annual amount of silt and sand mixture dredged. In Alabama near Montgomery, over 4 miles of levee construction is proposed along the Alabama River for flood control. This project could make use of 672,500 cubic yards of fill. Another major area in need of fill is the planned Battleship Parkway across the tip of Mobile Bay. The Corpus Christi area has designated economic development uses on some low lying land along the Gulf Coastline. Filling this land with 5 feet of cover would take 26 million cubic yards. Such a project could be filled in less than one year by applying a part of the dredged material obtained in the Galveston District area. A proposed dam along the Tallahola Creek in Pascagoula, Mississippi would need about 1.4 million cubic yards of fill to construct. Also, 45 miles of levee construction proposed along the Mississippi River would take 13.2 million cubic yards of fill.

72. These examples of planned projects clearly show local area needs for large quantities of fill material. It would appear that all of the present quantities of materials dredged annually in the Gulf States region could be disposed of for some multiple use project within relatively few miles from the source of dredging.

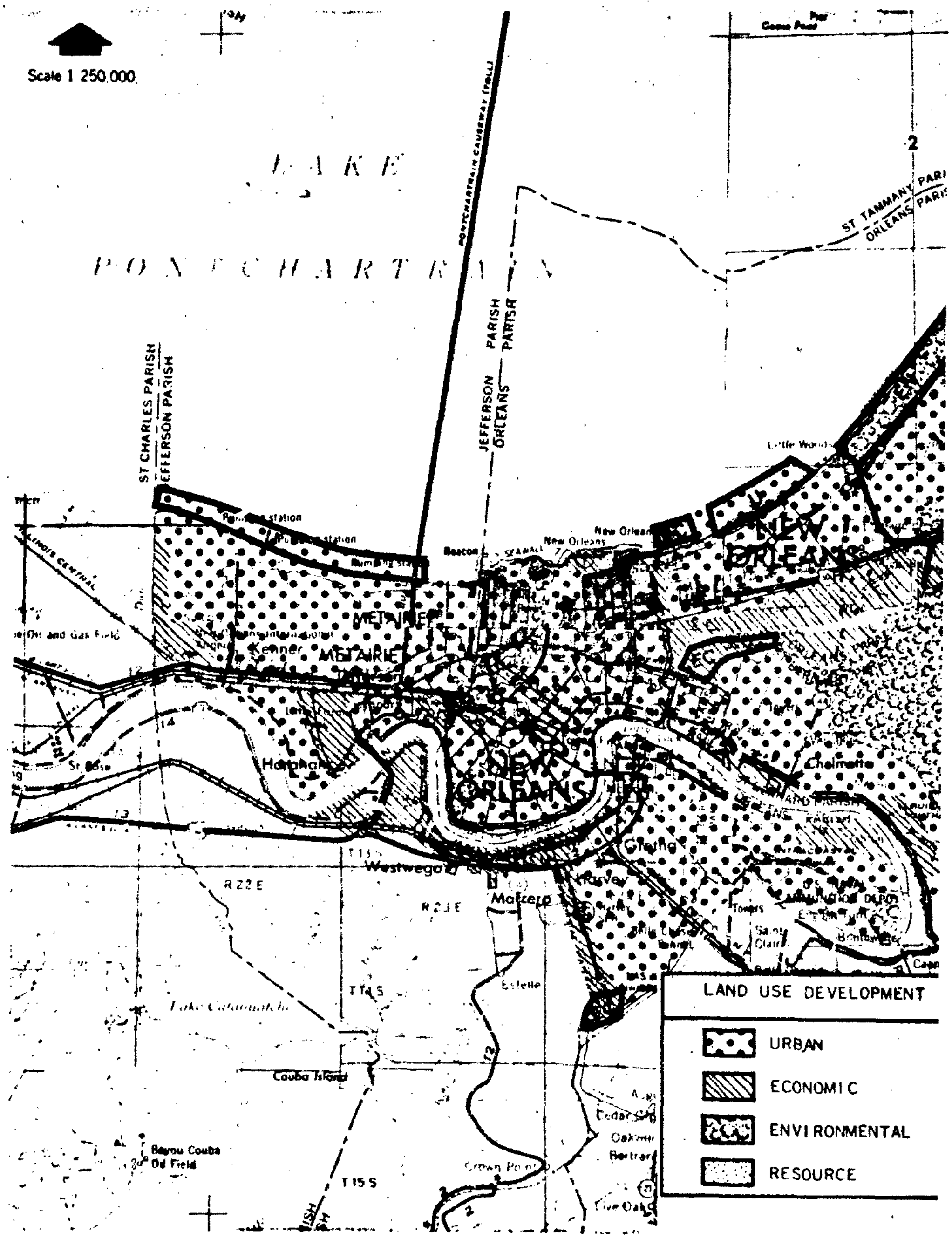
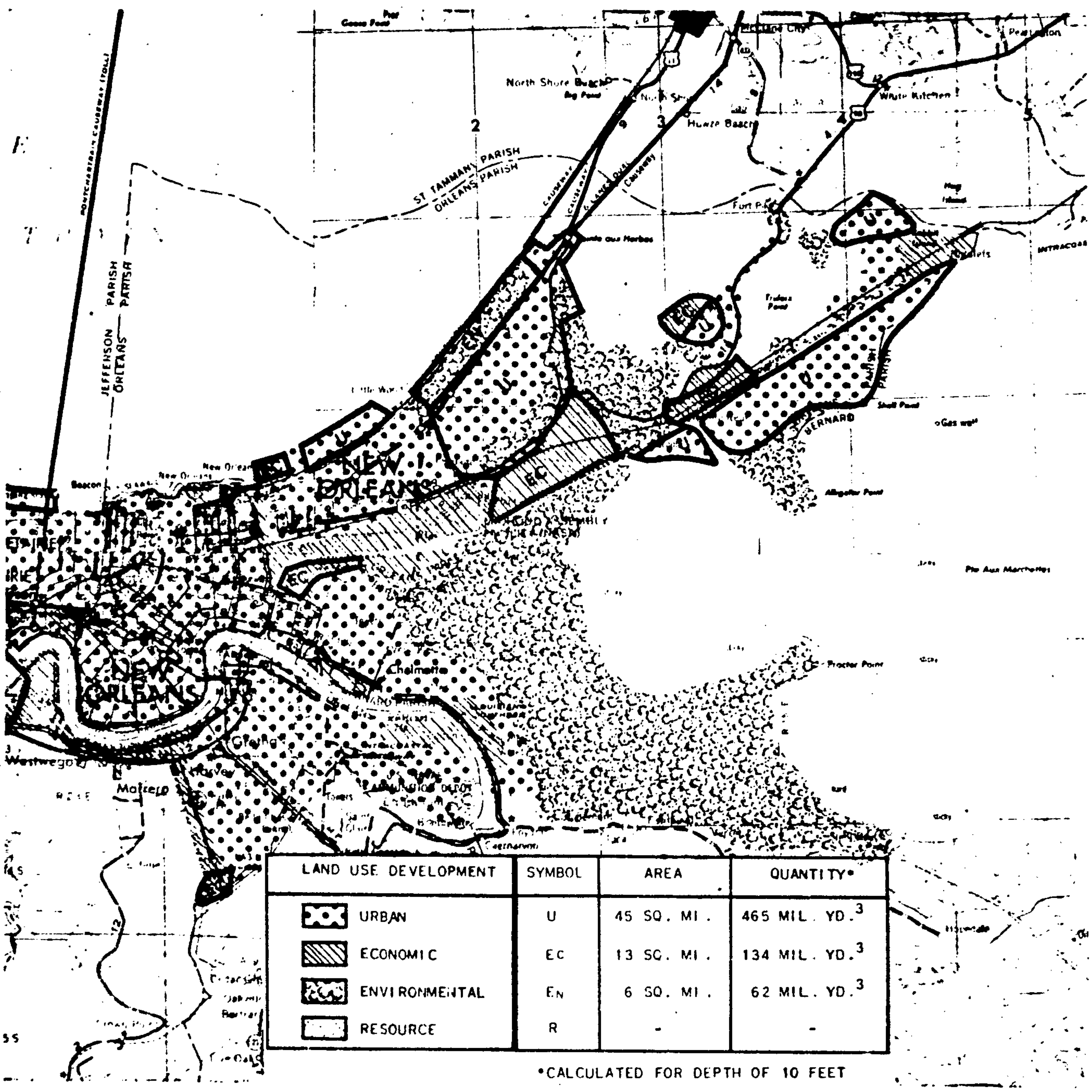


Fig.2.12 Generalized Regional Developr New Orleans Area



LAND USE DEVELOPMENT	SYMBOL	AREA	QUANTITY*
URBAN	U	45 SQ. MI.	465 MIL. YD.^{3}
ECONOMIC	EC	13 SQ. MI.	134 MIL. YD.^{3}
ENVIRONMENTAL	EN	6 SQ. MI.	62 MIL. YD.^{3}
RESOURCE	R	-	-

*CALCULATED FOR DEPTH OF 10 FEET

Fig.2.12 Generalized Regional Development Plan New Orleans Area

PART 3. SOUTH ATLANTIC REGION

General Characteristics

Physiography

73. Portions of the Piedmont and Folded Appalachian are contained within the boundaries of three of the four Districts comprising the study region; Florida being an exception, containing only Atlantic Coastal Plain province landforms. For the purposes of this study, and by virtue of its broad expanse, the Atlantic Coastal Plain province comprises the single, most important, physiographic feature and the dominant in the Southeastern Study Region. Of significance in the Atlantic Coastal Plain is the low, east-southeasterly topographic gradient which rarely exceeds 5 to 6 feet per mile. Landforms having significant topographic expression are virtually absent, creating a landscape of generally flat-to-gently undulating, topographically featureless surface.

74. Plate 2 shows the extent of the coastal plain in the study region. Figure 3.1 shows the four "coastal zones – A, B, C and D – are respectively, 0-25 miles, 25-50 miles, and 75-100 miles from the nearest harbor and navigation dredging operations conducted by the Corps from District Offices at Charleston, Wilmington, Savannah and Jacksonville. The numerous small projects conducted along the streams and extending inland have not been taken into consideration in defining these zones. Generally, the amounts of dredged material taken in these latter projects is relatively insignificant when compared to the coastal navigation and harbor projects. Additionally, disposal is a far less critical problem in the inland areas.

Socio-economic profile

75. The socio-economic profile discussed here is essentially confined to the study region itself, rather than the entire state. The discussion is brief and factual, intended to impart to the reader the salient character of the region and to allow some basis for the estimation of potential landfill and construction material requirements.

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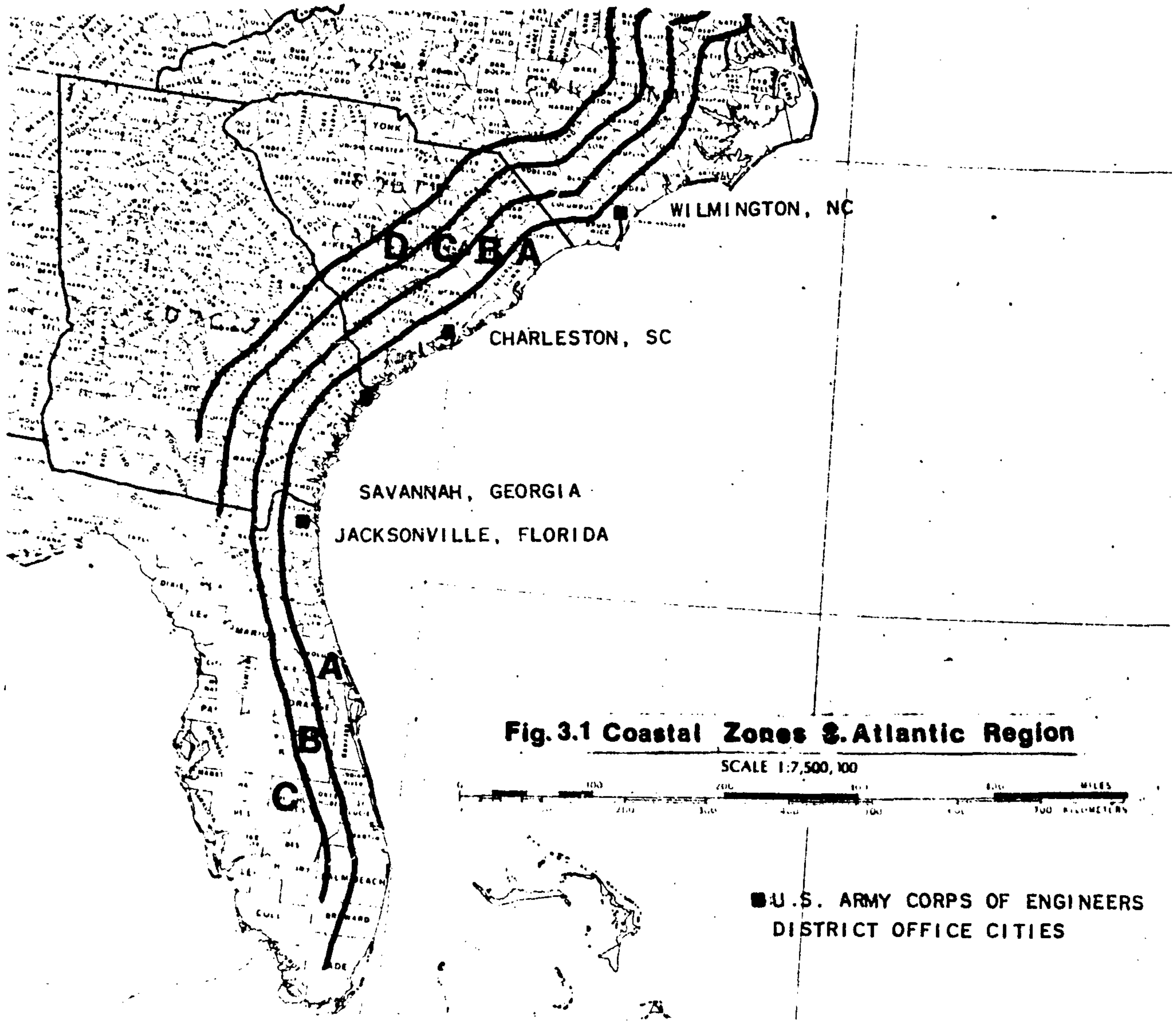


Fig. 3.1 Coastal Zones S. Atlantic Region

Population distribution and density

76. Figure 3.2 illustrates the distribution of the coastal zone population in absolute numbers and in terms of population density. They are arranged by coastal zone and state for convenience and later analysis in terms of the objectives of this project.

General Economic Profile

77. Table 3.1 provides select data for the General Economic Profile of South Atlantic Region States.

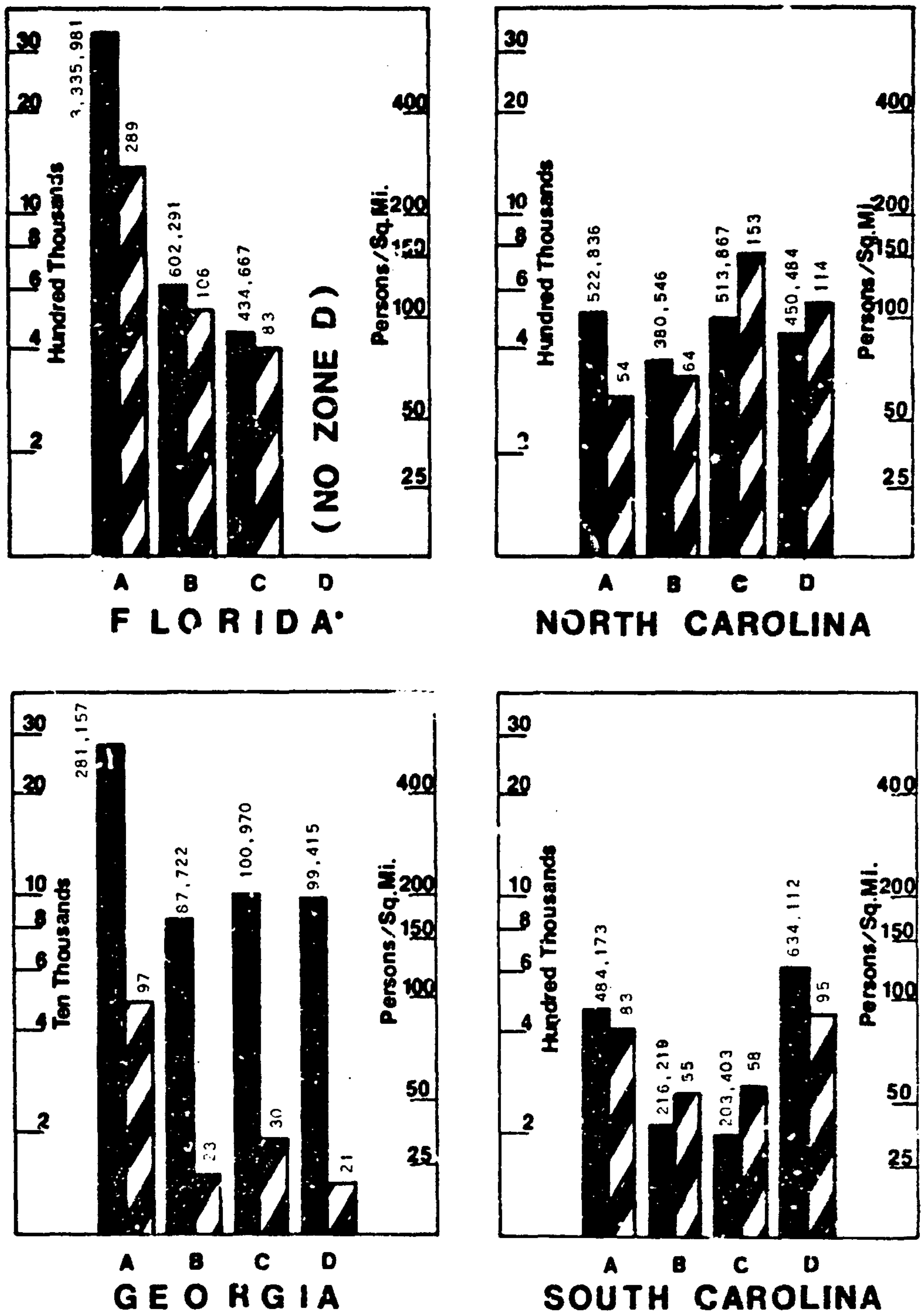
78. Minerals. The principal mineral wealth of the region consists, primarily, of sand, gravel, phosphate and clays.

80. Manufacturing. This is a steadily rising activity throughout the region, and for South Carolina, provides the major source of income for the state. Among the leading manufactured products of the South Atlantic Region are textiles, chemicals, apparel, paper products, food, and transportation equipment.

81. Tourism. This activity is, of course, a major industry and source of income for Florida, and a steadily rising producer of wealth in other parts of the study region.

Transportation

82. The region is endowed with an exceptionally good surface transportation network. The principal north-south highway on the east coast – Interstate 95 – passes through the region, linking virtually every major coastal city. All seaports and major cities have well-developed, radiating road nets connecting to inland cities. North-south rail transportation links the entire region, and spurs connect to the principal seaports and cities. All major cities have airports capable of handling intermediate to long-range jet aircraft. Coastal shipping as well as international shipping is of considerable importance, providing the raw materials for manufacturing and agriculture and for the shipment of products. Annual tonnages handles by some eleven ports in the region amounts to about 32,000,000 tons (1971).



*Atlantic Coast

Fig. 3.2 Population and Density by Coastal Zone — South Atlantic

Existing Development Trends

83. The South Atlantic Region consists of 11 SMSA's within the 100 mile limit established for this study. The development trend has been toward continued expansion in the areas surrounding existing cities. Services and development will most likely be expanded to keep up with this expected growth. Interpretation of data indicates that all of the SMSA's underwent substantial growth during the past ten years with the exception of Savannah, Georgia, which has a population loss of -0.3%. Growth is expected to continue as witnessed by the average population increase of 34.6% for the region. The four focal cities of Wilmington, Charleston, Savannah and Jacksonville are all in competition with each other for a regional "superport." Whichever city becomes the superport will undergo considerable growth due to increased job opportunities, construction and development, activity and economic expansion.

Availability of Dredged Material

Supply

84. In all Districts within the Southeastern Region the source of the bulk of the dredged material lies in the projects conducted for navigation maintenance of harbors, the Atlantic Inland Coastal Waterway (AIWW), channels and rivers. In addition, "new project" work provides additional supplies. Table 3.2 presents a breakdown of material supply by usage District. The new projects are undertaken on either a "one-shot" basis or they initiate what is to be an on-going maintenance program. Table 3.5 indicates the specific source of the material within the District, and Table 3.4 gives a breakdown of general physical characteristics.

Demand

85. Awareness of Availability. In virtually all cases, in all four Districts comprising the Southeastern Region, Port Authorities, local and regional planning entities, chambers of commerce, State Fish and Wildlife agencies, etc., displayed an awareness of the availability of dredged material. In addition, they had a general idea of quantities available, and a fair knowledge of the quality.

86. General Requests for Materials. Requests for materials are made on a fairly regular basis inasmuch as the above-cited groups are requested to act as "local sponsors" for specific fill projects. They are required to define the disposal site to be used, and to obtain the necessary permits for the disposal operations. This includes the preparation of environmental impact statements, arrangement for review of the proposed project by various concerned agencies, and making of formal application to the District Engineer. A Public Notice of the intent and scope of the project is issued by the Corps containing a plat of the proposed project (i.e., where the materials will be dredged from and where and how they will be disposed of). A response date is included. If the project succeeds in these steps, it is then placed in the Corps' next FY budget, and if funds are authorized, the project is undertaken.

Limitations affecting use of dredged material.

87. Economics. The economics of transport, sanitization and gradation are as yet not precisely determined other than that these functions may be costly. Competition with local borrow operations is currently out of the question. However, at such times as the traditional borrow operations are exhausted, or when local and state environmentalists place severe restrictions on these procedures, then the use of processed dredged material will undoubtedly become necessary and all counter-economic arguments will fall away. Transportability is a distinct factor affecting the economics of dredged material utilization. A limitation has generally been expressed concerning the ability to pump dredgings over 15,000 feet Although barging of material has not been practiced in the past, most rivers and streams in the Atlantic Coastal Plain are shallow but navigable for varying distances inland, presenting the possibility of another feasible transport mode. Rail and truck transportation of dredged material is not practical because the majority of the material dredged is fine-grained and of an extremely high water content.

88. Quality. The quality of the dredged material is, today, a limiting factor in its wider use as landfill. Salinity, pollutant levels and granularity inhibit planned use. To encourage use, and to meet federal, state and local standards, it will be necessary to process the dredged material to leach out the saline elements, "sanitize" the pollutants, and to grade the material.

89. Environmental Constraints. Environmental constraints on the disposal or emplacement of dredged material are fairly rigid and growing increasingly so. In the matter of the Corps traditional disposal sites in wetland areas, the restrictions are probably most stringent. Demands for greater use of confined disposal sites is growing, thereby raising the costs significantly. Environmentalists have cited the wetlands as being enormous generators of nutrients for the adjacent waters and their fish and shellfish life, and any encroachment upon these lands by disposed dredged material is, *a priori*, negated. Yet, it would seem that in many cases, insufficient argument has been forwarded by the Corps in defense of its operations in these areas. For example, these same nutrients introduced into the waters by the adjacent wetlands are mingled with the bottom materials that serve the aquatic life there. When they are dredged, they are merely returned to the wetlands and again reintroduced into the aquatic environment. Out-of-hand environmental constraints will require very close examination in order to genuinely determine their validity for restricting the disposal of dredged material.

Regional Landfills

Sampling of landfill projects

90. From discussions with Corps District personnel, and from a review of selected Public Notices and Environmental Impact Statements, a sampling of landfill projects utilizing dredged material was made. It should be cautioned that the sampling is intended more to identify "typical" projects than to generate any firm projection of landfill material needs. Matrix 3A locates an assessment of values placed on these sample projects. Values were put on the samples from 3 to 1. A value of 3 was placed on existing known uses

of dredged material and a value of 2 was placed on proposed uses. Proposed uses are those which have been planned but not yet under construction. A value of 1 was placed on potential uses which were suggested by the agencies contacted. Tables 3.5 through 3.8 give brief descriptions of projects reported in Matrix 3A. This sampling was related to the specified coastal zones as shown in Figure 3.1. Each use was related to its distance from the source of dredged material and not necessarily from the focal city in the region. From these values, a mean value was calculated for each of the four land development uses of urban, environmental, economic and resource activity. These values are plotted on graphs for each focal city as indicated in Figure 3.3.

91. It is evident from the graphs that existing and proposed uses are confined to the first 25 mile coastal zone and that only potential uses are being considered beyond the first 25 mile zone. This is due to the fact that dredged material is disposed in the immediate proximity of the dredging site. Transportation costs may become excessive for economic feasibility of the project if carried over 25 miles, even for open water disposal.

Example projects

92. In all four focal cities of Jacksonville, Savannah, Charleston and Wilmington, examples of land areas filled and developed with dredged material can be seen. Most of this filling was done on sites with immediate proximity to the dredging which helped to lower project costs. Areas in the region's harbors have been filled and used for industrial, commercial and marine facilities. Along the Intra-coastal Waterway, areas have been filled for residential and commercial developments. Emerald Isle, North Carolina, a residential development, was built on fill. The Jacksonville, Florida Sewage Treatment Plant was constructed utilizing dredged material. Lands which had previously been filled are now being used for farming. Artificial islands have been created and used as wildlife areas. Marine life has benefited in many areas because of newly created islands, flats, and shoals made with dredged material. The Annadale Plantation, North Carolina, has utilized dredged material in its studies concerning aquaculture. North Carolina is presently building new marshes utilizing dredged material and then planting them with cordgrass. [3.9]

MATRIX 3A

		SAMPLING OF LANDFILL PROJECTS	USACE DISTRICTS - COASTAL ZONES															
			JACKSONVILLE				SAVANNAH				CHARLESTON				WILMINGTON			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		COMMERCIAL	3	-	-	-	3	-	-	-	2	-	-	-	3	-	-	-
		RESORTS: COMMERCIAL CAMPS	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
		COMMUNITY FACILITIES	3	-	-	-	3	-	-	-	2	-	-	-	3	-	-	-
		MEAN	3.0	—	—	—	2.3	—	—	—	2.3	—	—	—	2.3	—	—	—
	ECONOMIC	INDUSTRIAL	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		RAIL; RAPID TRANSIT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		AIRPORTS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		HARBORS: PORTS	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		HIGHWAYS	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		UTILITIES	1	-	-	-	3	-	-	-	2	-	-	-	3	-	-	-
		MEAN	1.3	—	—	—	1.5	—	—	—	1.3	—	—	—	1.5	—	—	—
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	-	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
		MARINE NURSERIES	2	-	-	-	2	-	-	-	3	-	-	-	3	-	-	-
		BEACH NOURISHMENT	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		PARKS & RECREATION: PUBLIC*	2				3	-	-	-	3	-	-	-	3	-	-	-
		MARSHLAND MANAGEMENT	3	2	2	-	3	-	-	-	3	-	-	-	3	-	-	-
		SANITARY LANDFILLS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		OTHER LANDFILLS	3	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
		FLOOD PLAIN CONTROLS/LEVEES	3	2	2	-	3	-	-	-	3	-	-	-	3	-	-	-
		MEAN	2.1	0.5	0.5	—	1.8	—	—	—	2.5	—	—	—	2.6	—	—	—
	RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	2	-	-	-	3	-	-	-	3	-	-	-
		AGRICULTURAL/GRAZING LAND	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
		FORESTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BRICK MFG.: CERAMICS, ETC.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		LAND RECLAMATION	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		SAND & GRAVEL	3	-	-	-	3	-	-	-	3	-	-	-	-	-	-	-
		MATERIAL STOCKPILES	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
		MEAN	1.4	—	—	—	1.5	—	—	—	1.4	—	—	—	0.9	—	—	—
		MEAN VALUES	2.0	0.1	—	—	1.8	—	—	—	1.9	—	—	—	1.9	—	—	—

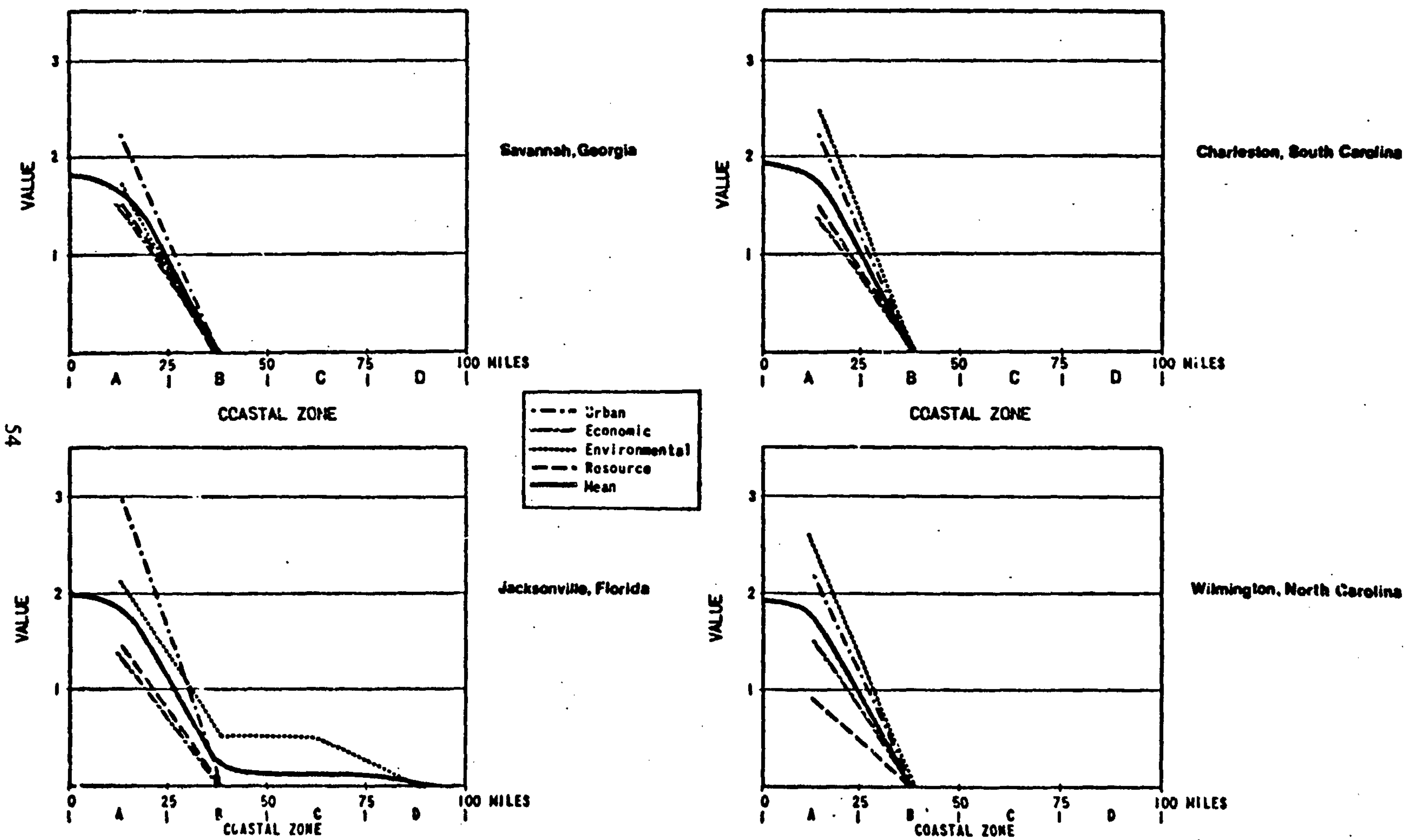


Fig. 3.3 Existing Landfill Projects
MATRIX 3A

93. The uses mentioned the most were beach nourishment, hurricane protection, and flood control projects. In Delray Beach, Florida, a beach nouirshment program was undertaken to control severe erosion and reduction of the available beach.[3.25] The beach erosion project is in Palm County and totals 12.2 miles. The portion of the project which includes Delray Beach provides for an initial fill in the form of a berm which will utilize 1.8 million cubic yards of dredged material over a 3 mile stretch and an annual nourishment program of 36,000 cubic yards. The material will be obtained from an offshore borrow site 2500 feet off the coast. At the Pee Dee and Waccamaw Rivers in South Carolina, 150,000 cubic yards of material have been dredged from the rivers strictly for fill material.[3.13] Dredged material is also being used in Florida strictly as fill using stockpiling. Proposed usage of dredged material parallels that of existing usage, however, proposals regarding the use in specific projects were not as extensive. The three primary uses were beach nourishment, hurricane protection, and flood control. Beach nourishment projects are proposed for Key West, Palm Beach and Duval County in Florida, Cape Lookout, North Carolina and also areas of Georgia and South Carolina. Beach nourishment at St. Lucie, Florida, is expected to be very beneficial to Loggerhead turtles which utilize the beach for nesting in spring and summer.[3.27] Hurricane protection projects were reported for Hillsborough Bay and Biscayne Bay, Florida, and North River, Topsail Beach, Surf City, and the Brunswick Beach, North Carolina.[3.8, 3.26.]

94. Other proposals listed for utilizing dredged material were in marina construction, Bogue Bay[3.5] and Neuss River,[3.7] North Carolina and bulkhead extensions as in Belle Island Marina, South Carolina, which would require 180,000 cubic yards of material. In Savannah, Georgia, it was proposed to utilize dredged material in the construction of an offshore island which would be used as a transhipment terminal for the port.[3.20] One unique proposal, shown in Figure 3.4, which exemplifies a variety of uses for dredged material is that of the "Rebellion Road Project" at Hog Island, Charleston Harbor, South Carolina.[3.12] Hog Island is a 500 acre former disposal site for the Corps of Engineers. It has been proposed to develop this acreage as a tourist attraction and a

THE DEVELOPMENT

The total development is anticipated to take the form as indicated below, with approximate acreage allocations as follows:

Navy Museum	35 acres
Seaquarium	20 acres
Theme Park	90 acres
Parking	70 acres
Natural Parks	90 acres
Transient Lodgings and Marina	96 acres
Roads and Uncommitted Uses	100 acres

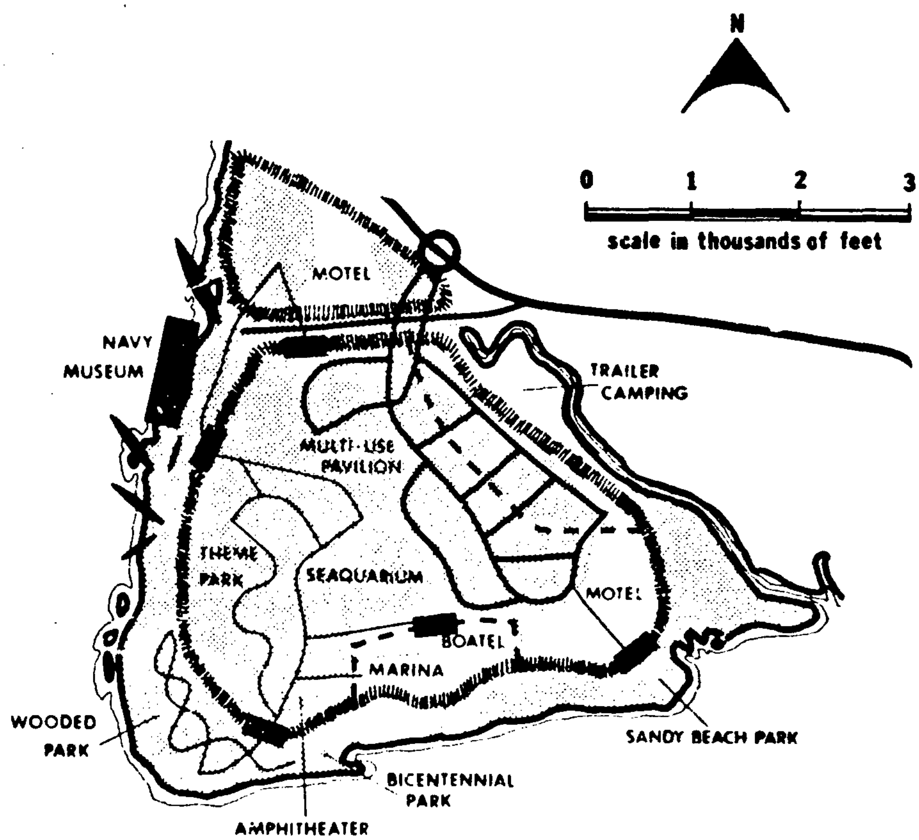


Fig.3.4 Proposed Development of Rebellion Road, South Carolina

park. The main elements comprising this park are a Navy Museum and a Seaquarium. Provisions are being made for a motel complex, restaurants, boatel, convention center, marina and trailer camping sites. Other developments included in the plan are for retail sales, gift shops, curiosity shops, refreshment stands and possibly an outdoor sports arena. Along with this an amphitheater is to be constructed, parking facilities and internal transportation considerations. Outside of the existing dike is to be beach and wooded areas. Another proposed project utilizing dredged material is the development of Blount Island, Jacksonville, Florida as outlined in a Corps of Engineers' Environmental Impact Statement. 3.29. The purpose of the project is to modify 950 acres on Blount Island for industrial development by Offshore Power Systems. The facility to be developed will construct, assemble, and test floating nuclear plants. Total excavation for the project will involve the utilization of 12.5 million cubic yards of dredged material. Only the dredging necessary to accomplish the function of the facility will be undertaken. The site will also require bulkheading for 24,000 linear feet to elevation +9 MSL and filling and grading of the site will be done to attain this elevation. Figure 3.5 shows a map of the proposed project.

Potential Landfill Projects

95. Matrix 3B on Potential Landfill Projects is designed to compare a selected group of potential uses where landfill is generally required, for the South Atlantic Region. Values were placed on these specific uses from 3 to 1. A value of 3 would have the greatest potential, 2 would have a moderate potential, and a value of 1 would have the least potential. Affecting these allotted values were factors which pertained to the South Atlantic Region such as population density, topography of the region, known areas of expansion and also distance from the source. The matrix is divided into four divisions of potential landfills urban, economic, environmental and resource. It is further divided into 25 mile increments as designated by columns "A" through "D" which are the coastal zones shown in Figure 3.1. From these values, a mean value was calculated for each land use development category and a mean value for the combination of all four categories. These values were then plotted on graphs for each focal city in the South Atlantic Region; Figure 3.6.

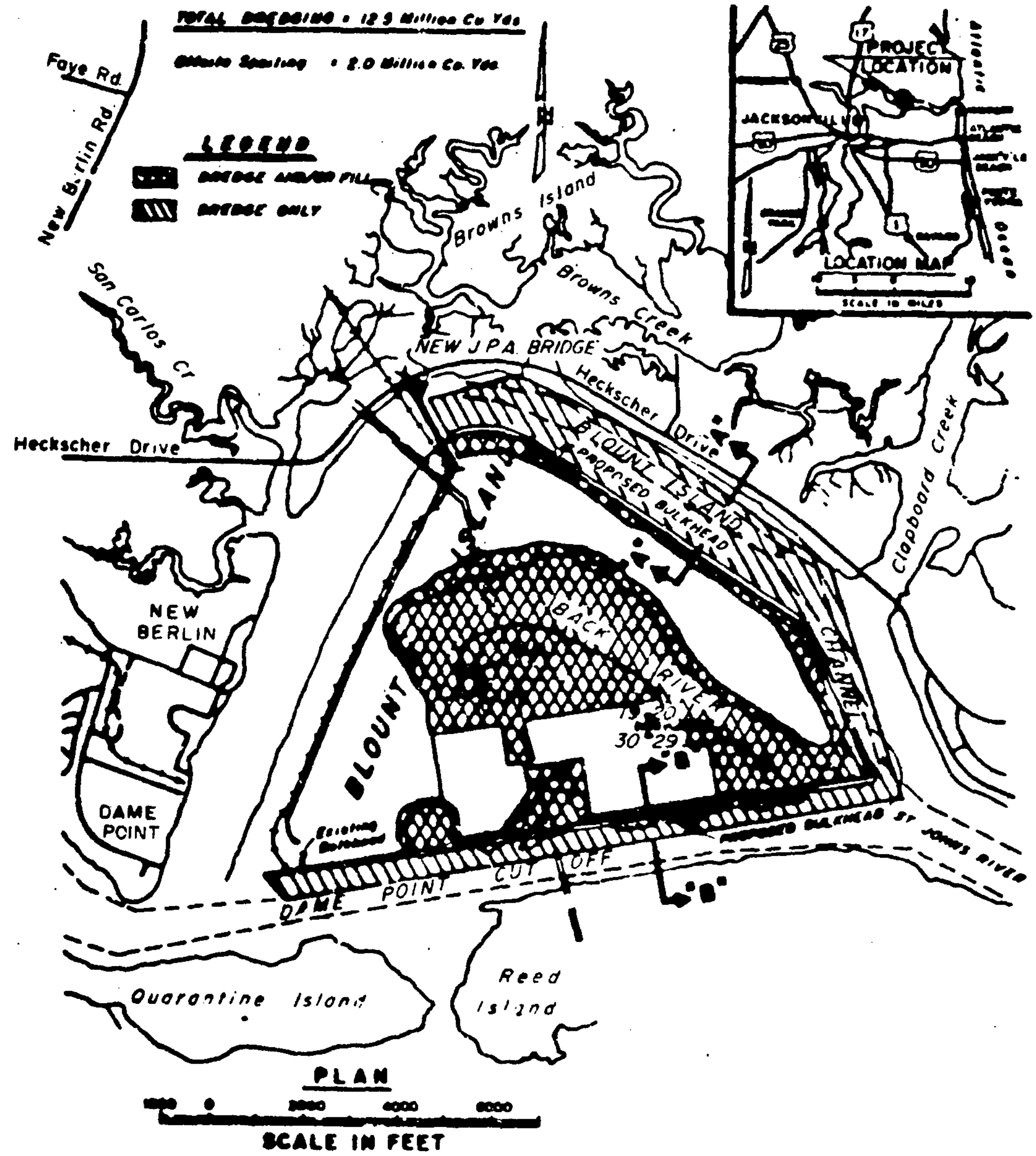


Fig.3.5 Proposed Bulkhead, Dredge and Fill at Blount Island

MATRIX 3B

LAND USE DEVELOPMENTS		POTENTIAL LANDFILL PROJECTS	USACE DISTRICTS - COASTAL ZONES															
			JACKSONVILLE				SAVANNAH				CHARLESTON				WILMINGTON			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
	URBAN	RESIDENTIAL; HOUSING	3	2	1	-	3	2	2	1	3	2	2	3	3	2	2	2
		COMMERCIAL	3	2	1	-	3	1	1	-	2	2	1	1	3	2	1	1
		RESORTS; COMMERCIAL CAMPS	3	2	1	-	3	2	2	-	3	2	2	2	3	2	2	2
		COMMUNITY FACILITIES	3	2	1	-	3	1	1	-	2	2	1	2	3	2	2	2
		MEAN	3.0	2.0	2.0	—	3.0	1.5	1.5	0.3	2.5	2.0	1.5	2.0	3.0	2.0	1.8	1.8
	ECONOMIC	INDUSTRIAL	2	3	2	-	3	2	2	1	3	2	2	3	3	2	3	2
		RAIL; RAPID TRANSIT	3	1	1	-	3	1	1	1	3	1	1	3	2	2	3	2
		AIRPORTS	2	2	1	-	2	1	1	1	2	1	1	1	1	1	2	2
		HARBORS; PORTS	3	1	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		HIGHWAYS	3	2	1	-	3	1	2	1	3	2	2	3	2	2	2	2
		UTILITIES	3	3	1	-	3	1	1	1	2	2	2	2	3	2	2	2
		MEAN	2.7	1.8	1.0	—	2.8	1.0	1.2	0.8	2.7	1.3	1.3	2.0	2.2	1.5	2.0	1.7
	ENVIRONMENTAL	WILDLIFE REFUGES; ROOKERIES	3	3	3	-	3	2	2	1	3	2	1	-	3	2	2	-
		MARINE NURSERIES	3	2	1	-	3	1	1	1	2	1	1	-	3	2	2	-
		BEACH NOURISHMENT	3	2	-	-	3	2	2	1	3	2	2	3	3	-	-	-
		PARKS & RECREATION: PUBLIC	3	2	3	-	3	2	2	1	3	2	2	3	3	3	3	3
		MARSHLAND MANAGEMENT	3	3	2	-	3	2	1	-	3	2	1	-	3	2	1	-
		SANITARY LANDFILLS	3	3	2	-	3	2	3	1	3	2	2	3	3	2	2	
		OTHER LANDFILLS	3	3	3	-	2	3	3	1	1	1	1	2	1	1	1	2
		FLOOD PLAIN CONTROLS/LEVEES	3	3	2	-	3	3	2	1	3	2	2	-	3	2	2	-
		MEAN	3.0	2.6	2.0	--	2.9	1.9	1.8	0.8	2.6	1.5	1.3	1.0	2.8	1.1	1.6	1.0
	RESOURCE	ARTIFICIAL ISLANDS	1	-	-	-	3	-	-	-	3	2	-	-	3	2	-	-
		AGRICULTURAL/GRAZING LAND	2	2	2	-	2	3	2	1	1	1	2	2	1	3	-	1
		FORESTRY	1	2	2	-	1	1	2	2	1	2	2	3	-	-	2	2
		BRICK MFG.: CERAMICS, ETC.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		LAND RECLAMATION	3	3	2	-	2	2	2	1	3	2	2	-	3	2	2	-
		SAND & GRAVEL	3	3	-	-	2	2	-	-	3	2	1	-	3	2	1	-
		MATERIAL STOCKPILES	3	3	-	-	3	3	-	-	3	3	-	-	3	2	-	-
		MEAN	1.8	1.8	0.8	-	1.8	1.5	0.8	0.5	2.0	1.7	1.0	0.7	0.8	1.7	0.7	0.4
		MEAN VALUES	2.6	2.1	1.2	—	2.6	1.4	1.3	0.6	2.4	1.6	1.3	1.4	2.4	1.7	1.5	1.2

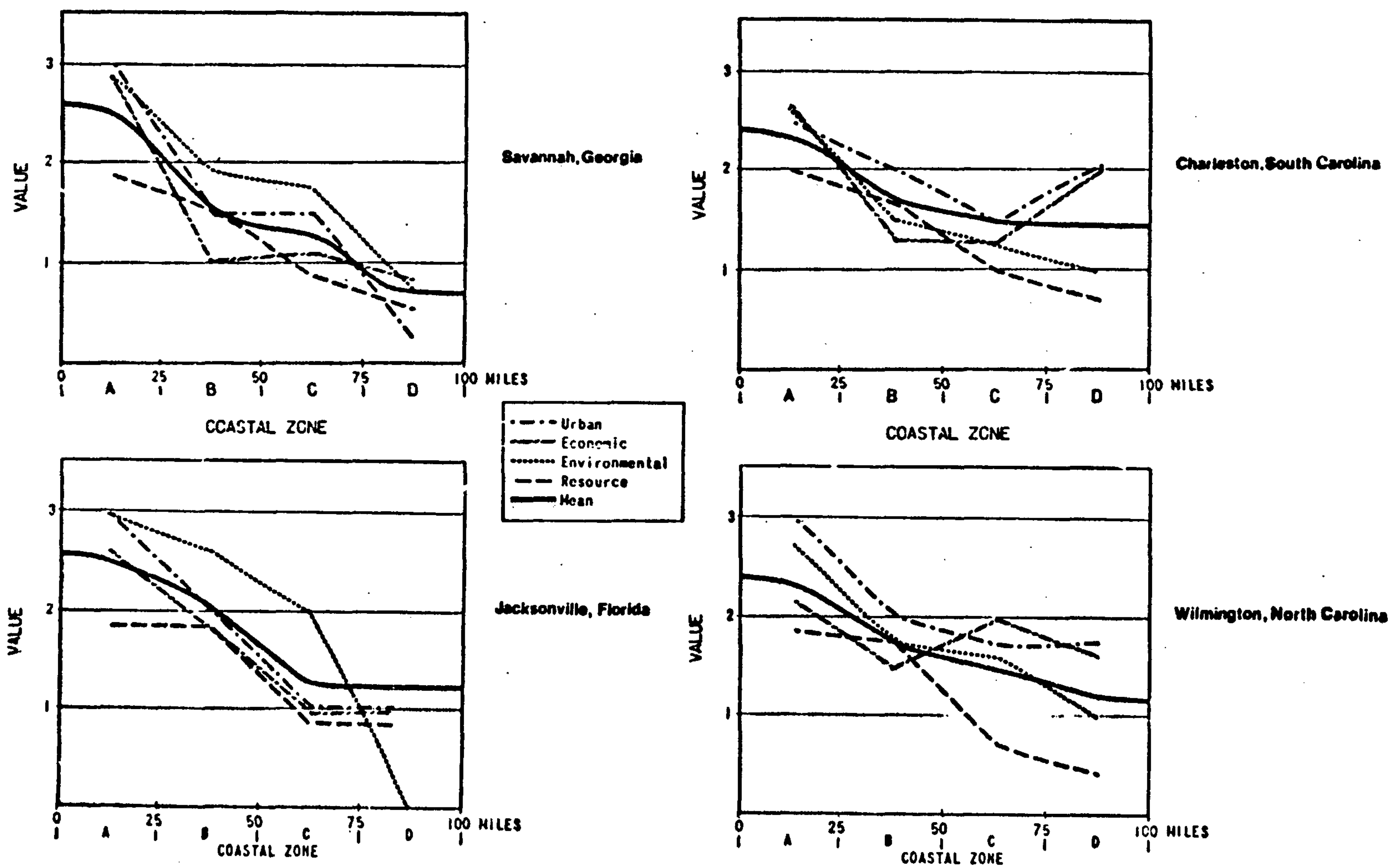


Fig. 3.6 Potential Landfill Projects
MATRIX 3B

96. The greatest potential for dredged material is in the first coastal zone as shown on the graphs. These curves fall rather rapidly for Jacksonville and Savannah because of the swampy topography of the two areas and the low population density inland. The graphs for Charleston and Wilmington, however, level off beyond the first 25 miles due to expansion and high population density inland of which will generate a greater need for fill material. A potential use which would require large quantities of fill material would be in flood control. A good example of this is shown in "Resource and Land Information for South Dade County, Florida". 3.30 Large areas of this county were periodically flooded by storm run-off until a network of drainage canals was constructed. These drainage canals have significantly reduced the flooding but some low areas are still flooded. A lack of fill material may inhibit development of these areas. The Dade County Public Works Department has established minimum elevations for all new roads and development in the area. These elevations were established to minimize damage from periodic flooding and also to insure proper functioning of septic systems which are the sole method of wastewater disposal. Land areas below these minimum elevations cannot be developed until they are filled to required depth. As much as five feet of fill is required before certain areas can be utilized. Figure 3.7 shows a map of South Dade County, Florida, which has these areas noted. An analysis of this map gives an estimated area of 110 square miles requiring fill 3 feet to 5 feet deep, and 189 square miles requiring up to 3 feet deep. Using average depths these two areas would generate an average requirement for 465 million cubic yards and 303 million cubic yards of fill respectively. This area alone could accommodate all disposal of the dredged material from the entire South Atlantic Region for many years.

97. The four focal cities in the South Atlantic Region are in direct competition with each other to become the "Superport" for the southern coast. The concept of a superport is founded upon the need for deep draft shipping ports and the ways to accommodate them. The Metropolitan Planning Commission of Savannah, Georgia, has prepared the "Savannah Seaport Study", which deals with developing Savannah into a regional port. 3.20 Generally, port planners and developers are directing new growth of

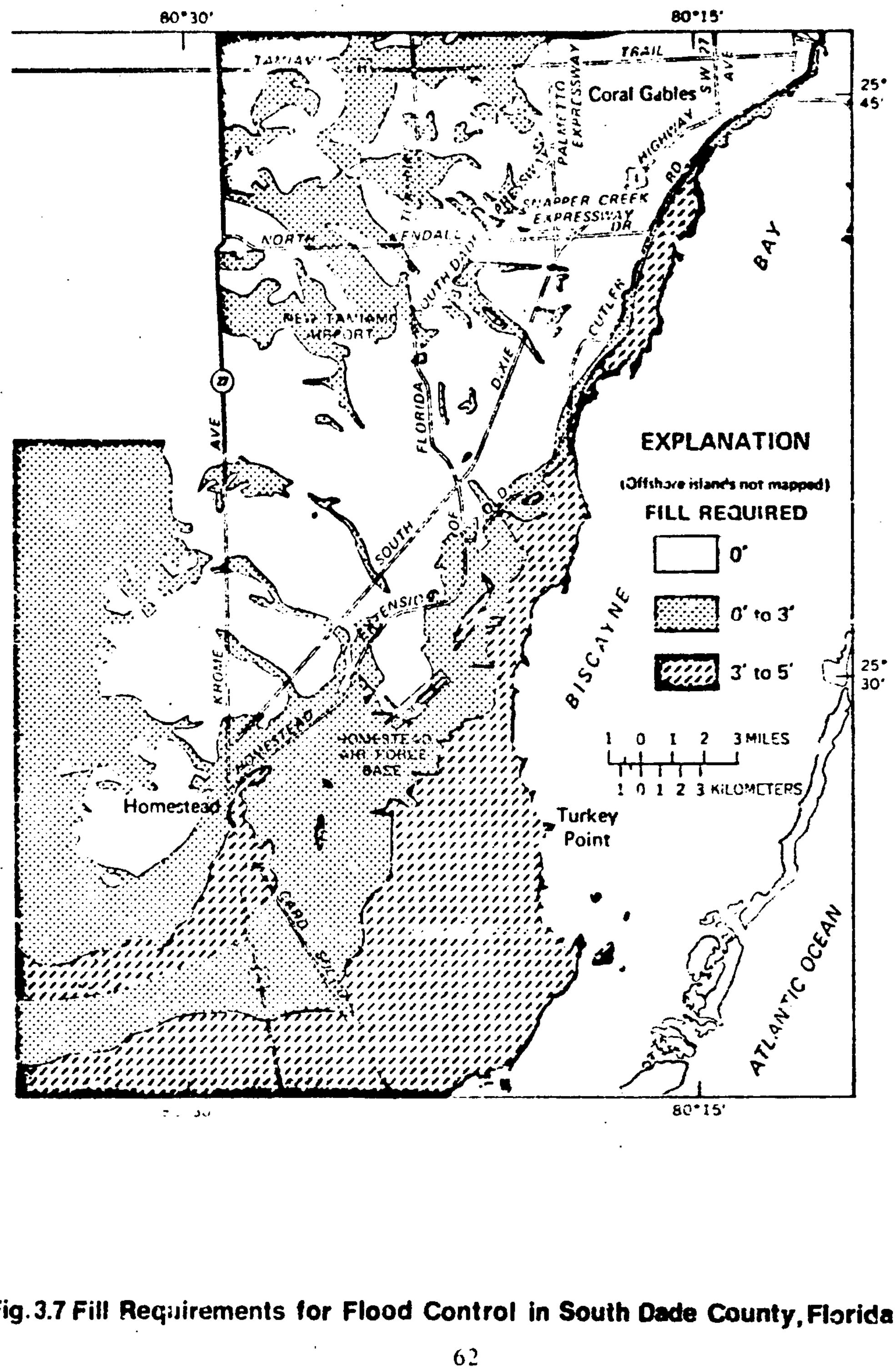


Fig.3.7 Fill Requirements for Flood Control in South Dade County, Florida

ports and facilities closer to the sea. It is proposed in this study that Savannah's growth should also be towards the sea and recommendations for carrying this out are made. The recommendations point out that the land used as disposal sites have actually been "enhanced" by this disposal. That presently, for Savannah's port to expand towards the sea it must acquire these disposal easements and utilize them for industrial development at the regional port. The potential results of lands enhanced, and required for development, is shown on Figure 3.8 which was excerpted from "Savannah's Seaport Study". Another recommendation pointed out that dredged material should be considered as a resource and "spoil areas be selected with the view to their incorporation, incrementally, into the port complex as the material deposited builds into usable land".

Quantitative assessment.

98. Matrix 3C is designed to provide a quantitative assessment of dredged material which could be utilized for specific uses related to urban, economic, environmental, and resource land developments. Values have been placed on the uses from 3 to 1. A value of 3 would denote an assessment of over 2,500,000 million cubic yards. A value of 2 would be for an assessment of from 500,000 cubic yards to 2,500,000 cubic yards, and a value of 1 would be an assessment less than 500,000 cubic yards. The matrix is also divided into 25 mile increments as designated by columns "A" through "D" which are the coastal zones designated on Figure 3.1. From these values, a mean value was calculated for the four categories of urban, economic, environmental and resource, and a mean value for the combination of the four categories. These values are plotted in Figure 3.9 for each focal city in the South Atlantic Coast Region.

Sample of future land use and development plans.

99. An area, selected to "testify" the growth of the region, was analyzed in terms of potential requirements for landfill over the next twenty-seven years. The analysis is limited and speculative, but it does serve to suggest the magnitude of the potential requirement and, if extrapolated over the entire region implies that a considerable need does currently exist and will continue to exist for quite some time. A four-county area in Coastal

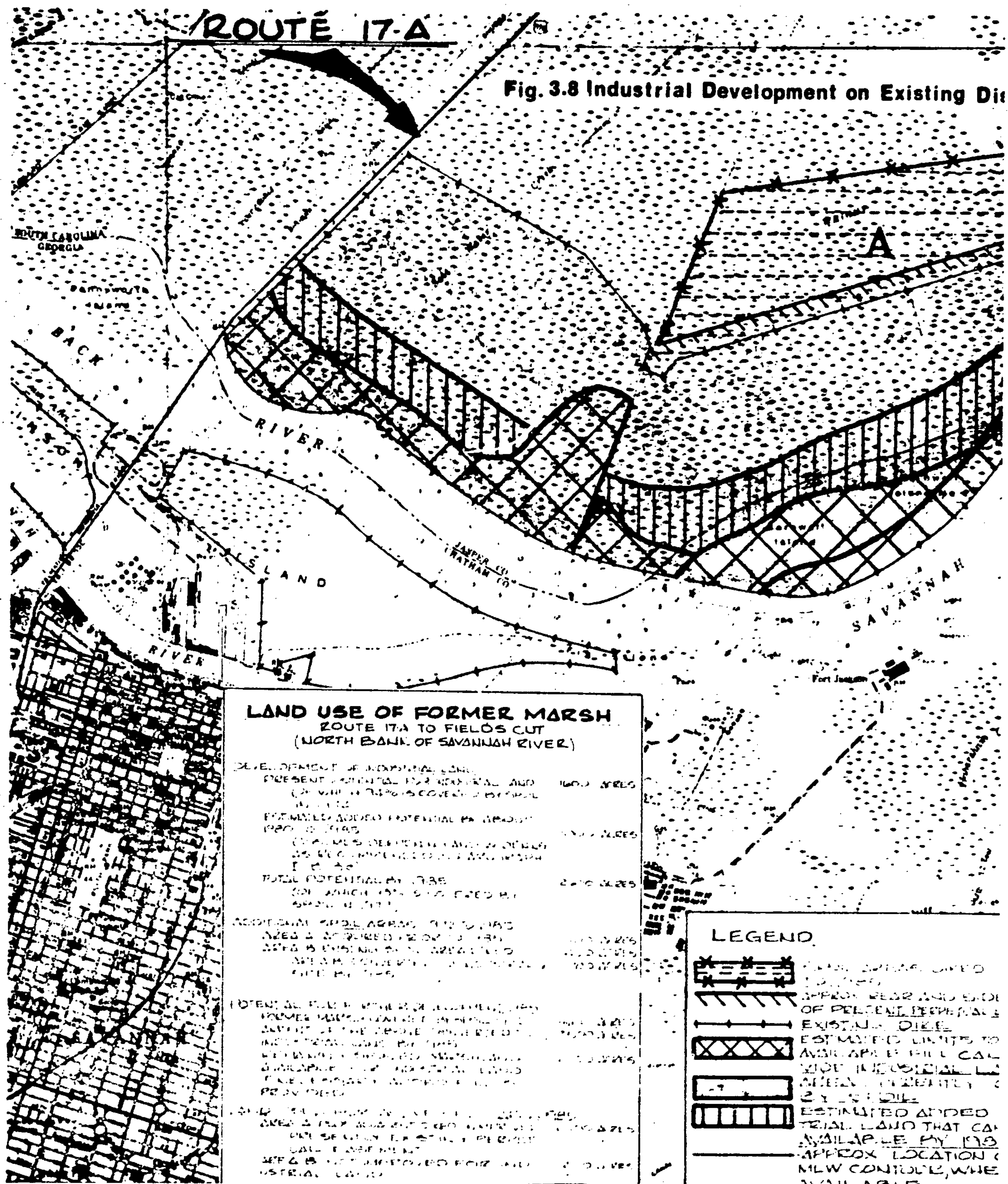


Fig. 3.8 Industrial Development on Existing Di

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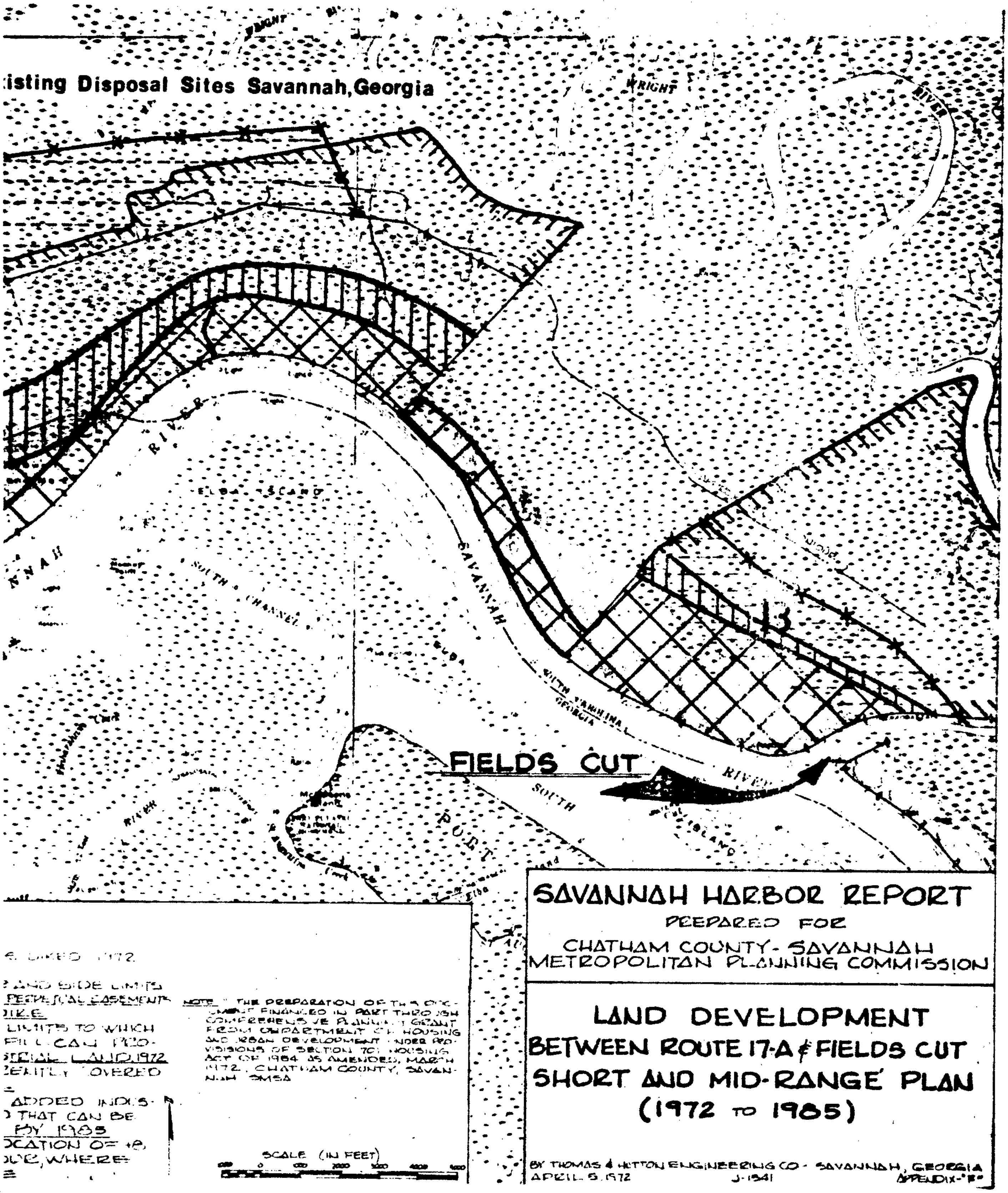
Existing Disposal Sites Savannah, Georgia
WRIGHT
RIVER
SAVANNAH
ELBA ISLAND
SOUTH CHANNEL
SOUTH CAROLINA
GEORGIA
FIELDS CUT
SOUTH
RIVER
PORT
SAVANNAH HARBOR REPORT
PREPARED FOR
CHATHAM COUNTY - SAVANNAH
METROPOLITAN PLANNING COMMISSION
LAND DEVELOPMENT
BETWEEN ROUTE 17-A & FIELDS CUT
SHORT AND MID-RANGE PLAN
(1972 TO 1985)
BY THOMAS & HUTTON ENGINEERING CO. - SAVANNAH, GEORGIA
APRIL 5, 1972
J-1341
APPENDIX-"E"
SCALE (IN FEET)
NOTE: THE PREPARATION OF THIS DOCUMENT FINANCED IN PART THROUGH COMPREHENSIVE PLANNING GRANT FROM DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT UNDER PROVISIONS OF SECTION 701 HOUSING ACT OF 1954 AS AMENDED, MARCH 1972, CHATHAM COUNTY, SAVANNAH SMSA

MATRIX 3C

QUANTITATIVE ASSESSMENT			JACKSONVILLE A	JACKSONVILLE B	JACKSONVILLE C	JACKSONVILLE D	SAVANNAH A	SAVANNAH B	SAVANNAH C	SAVANNAH D	CHARLESTON A	CHARLESTON B	CHARLESTON C	CHARLESTON D	WILMINGTON A	WILMINGTON B	WILMINGTON C	WILMINGTON D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	3	2	2	-	3	2	2	2	3	1	1	2	3	1	1	2
		COMMERCIAL	3	1	1	-	3	2	1	-	2	1	1	1	2	[illegible]	1	2
		RESORTS: COMMERCIAL CAMPS	1	1	1	-	1	1	1	-	1	1	1	1	1	1	1	1
		COMMUNITY FACILITIES	2	1	1	-	2	1	1	-	2	1	1	-	2	1	1	2
		MEAN	2.2	1.2	1.2	—	2.2	1.5	1.2	0.5	2.0	1.0	1.0	1.0	2.0	1.0	1.0	1.8
	ECONOMIC	INDUSTRIAL	3	1	1	-	3	2	1	1	3	1	1	2	3	1	2	1
		RAIL: RAPID TRANSIT	2	1	1	-	3	1	-	-	2	1	2	3	1	-	2	1
		AIRPORTS	3	3	-	-	3	-	-	-	3	1	1	2	2	1	1	2
		HARBORS: PORTS	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		HIGHWAYS	2	2	1	-	3	2	2	2	2	2	2	2	2	2	2	2
		UTILITIES	2	1	1	-	2	2	2	1	2	1	1	2	2	1	1	2
		MEAN	2.5	1.3	0.6	—	2.8	1.2	0.8	0.6	2.5	1.0	1.2	1.8	2.2	1.5	1.3	1.3
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	3	2	2	-	3	2	2	1	3	2	2	-	3	1	1	-
		MARINE NURSERIES	3	1	1	-	3	1	1	1	2	1	1	-	2	1	1	-
		BEACH NOURISHMENT	3	1	-	-	3	-	-	-	3	-	-	-	3	-	-	-
		PARKS & RECREATION: PUBLIC	2	1	1	-	2	1	1	1	2	1	1	2	2	1	1	2
		MARSHLAND MANAGEMENT	3	2	1	-	3	3	2	-	3	3	2	-	3	3	1	-
		SANITARY LANDFILLS	2	1	1	-	3	1	1	1	2	1	1	2	2	1	1	2
		OTHER LANDFILLS	1	1	1	-	1	1	1	1	1	1	1	1	1	1	1	1
		FLOOD PLAIN CONTROLS/LEVEES	2	1	1	-	2	2	2	1	2	2	2	-	2	2	2	-
		MEAN	2.3	1.2	1.0	—	2.5	1.3	1.2	0.7	2.2	1.3	1.2	0.6	2.2	1.2	1.0	0.6
	RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	3	-	-	-	3	1	-	-	3	1	-	-
		AGRICULTURAL/GRAZING LAND	1	1	1	-	2	2	2	1	1	1	2	2	1	1	2	2
		FORESTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BRICK MFG.: CERAMICS, ETC.	2	2	2	-	3	2	2	1	3	2	2	-	3	2	2	-
		LAND RECLAMATION	2	1	-	-	1	1	-	-	2	1	1	-	2	1	1	-
		SAND & GRAVEL	2	1	-	-	2	1	-	-	2	1	-	-	2	1	-	-
		MATERIAL STOCKPILES	2	1	-	-	2	1	-	-	2	1	-	-	2	1	-	-
		MEAN	1.6	0.8	0.5	—	1.7	1.0	0.7	0.4	1.7	1.0	0.8	0.4	1.6	[illegible]	0.8	0.4
		MEAN VALUES	2.2	1.2	0.8	—	[illegible]	1.2	1.0	0.5	2.1	1.1	1.0	0.9	2.0	1.0	1.0	1.0

(Column heading: USACE DISTRICTS - COASTAL ZONES)

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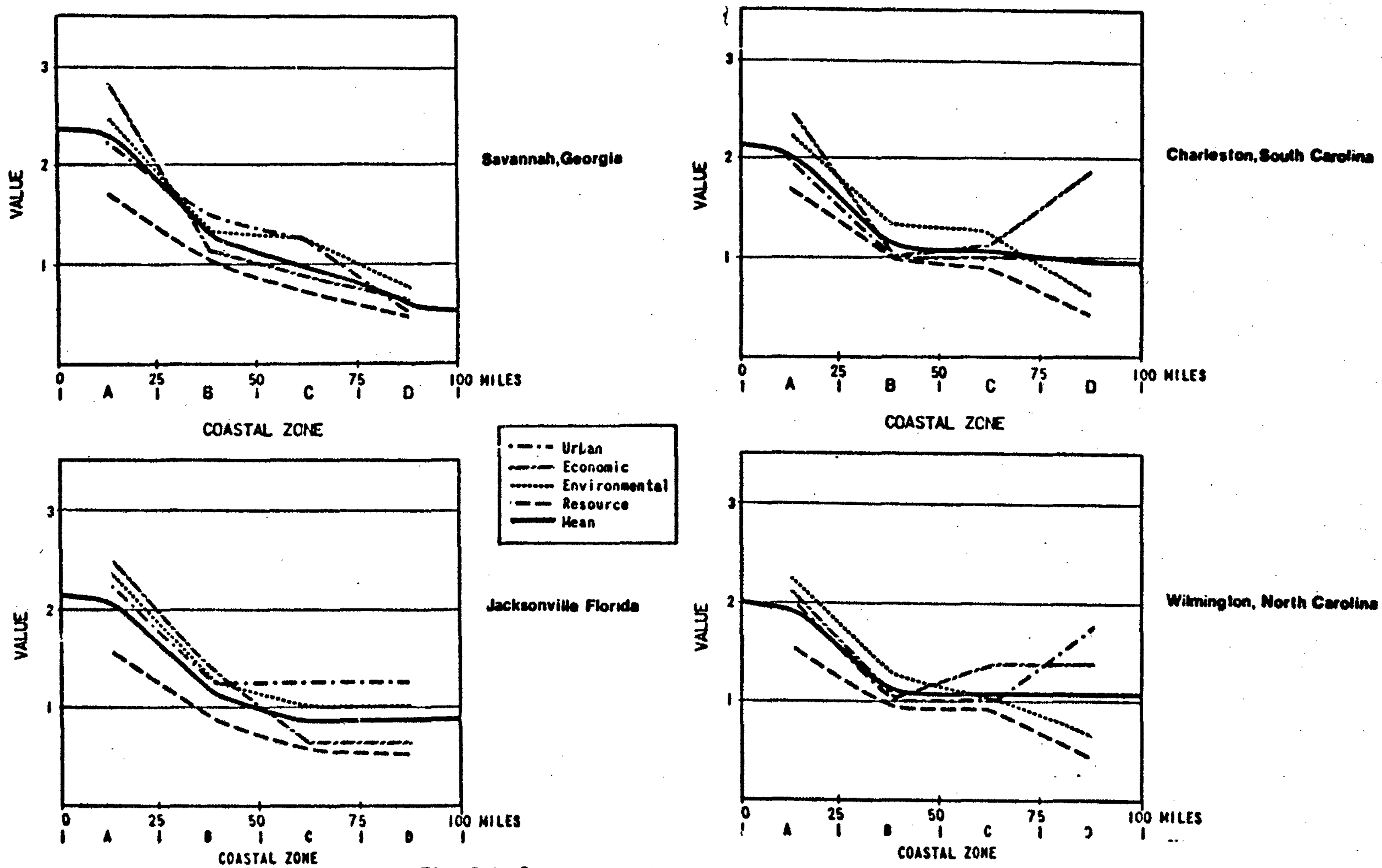

Fig. 3.9 Quantitative Assessment
MATRIX 3C

Zone "A" at Wilmington, North Carolina was chosen for this analysis, as indicated in Figure 3.10. The rationale for selection was predicated upon the fact that the information available to the study was current and accurate. The four counties – Brunswick, Columbus, New Hanover and Pender – are marked by the extensive development of swamp and marsh lands. Analysis of the planning document, "Regional Development Guide for the Year 2000" prepared by the Cape Fear Council of Governments, shows that approximately 1317 square miles of this indurated land surface is comprised of four land-use categories:

Urban areas (U)
Economic (Ec)
Environmental (En)
Resource (R)

For the purpose of gaining an insight into the order of magnitude of landfill requirements, it was estimated that the entire 1317 square mile area would indeed undergo development as shown in the Year 2000 plan, and would be covered to the depths shown on Figure 3.10. Similarly, it is estimated that 84 miles of new road construction is proposed to serve as intra-regional and major arterial routings. Of this, some 54 miles will traverse swamp and marsh lands. The assumption was made of a roadway 100 feet wide and filled with 10 feet of material in the non-indurated segments, and of a 100 foot roadway width and 20 feet of fill in the indurated segments. This would generate a requirement of some 22 million cubic yards of fill.

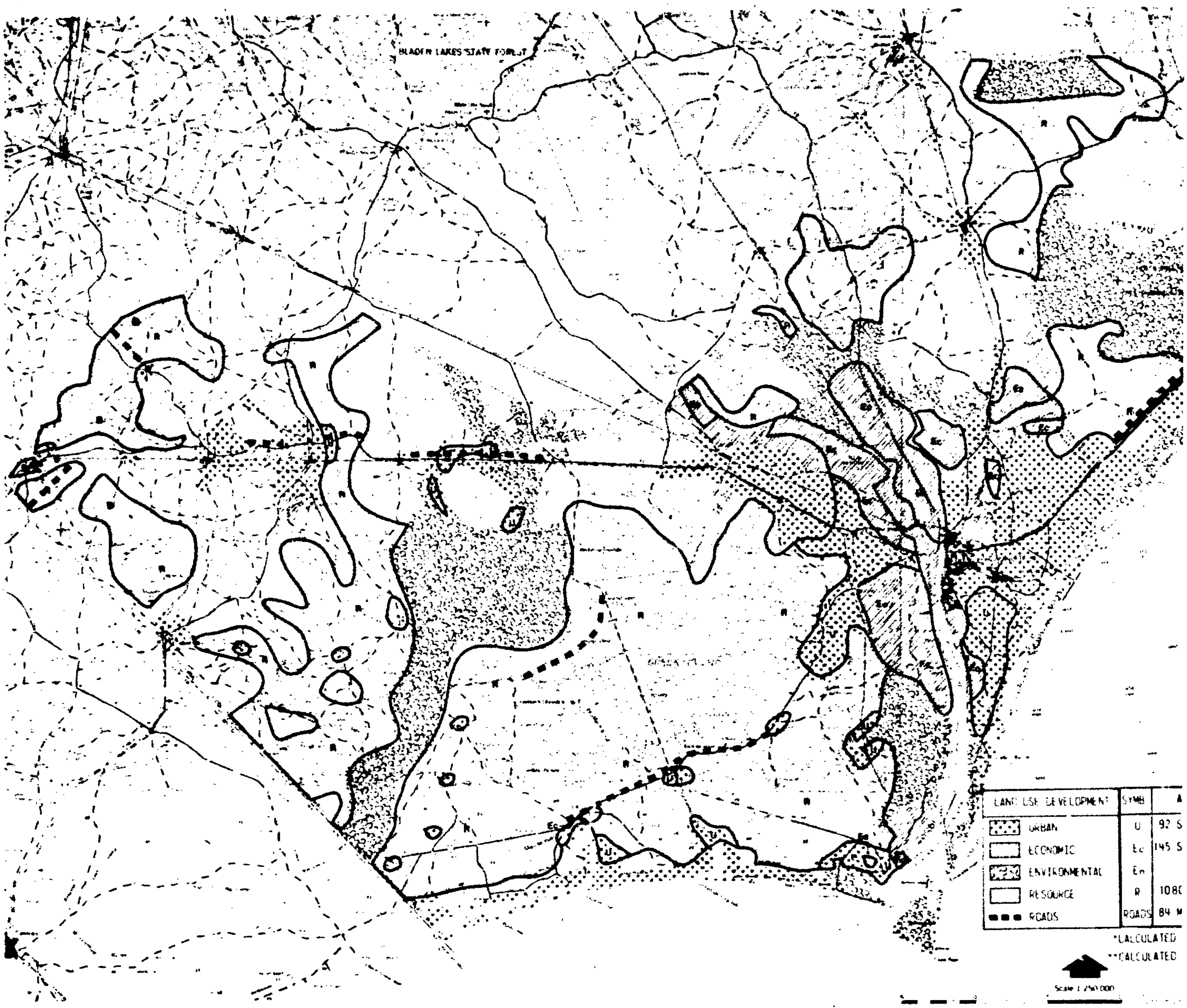

Fig.3.10Generalized Regional Development Plan
Wilmington,N.C. Area

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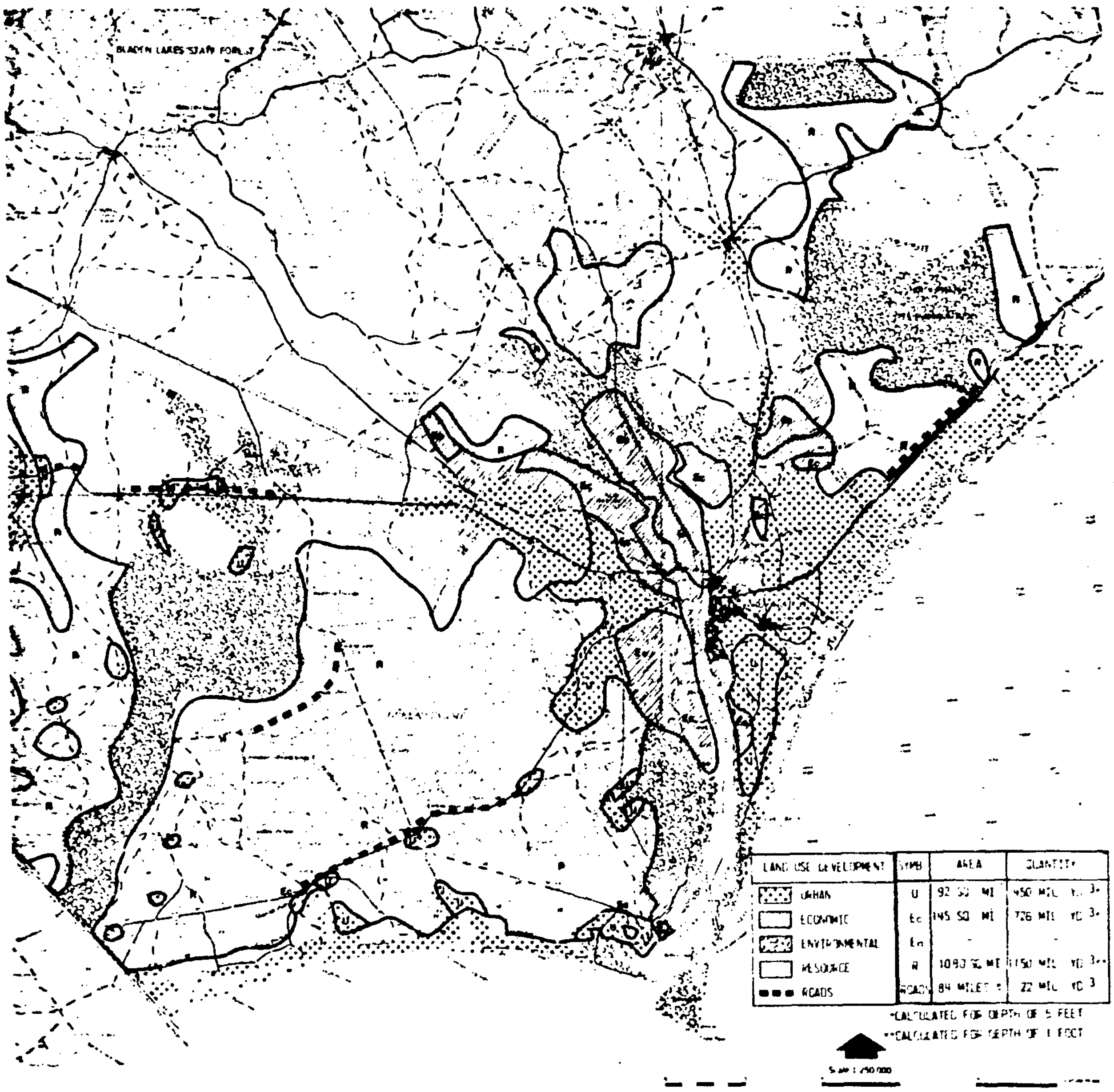

Fig.3.10 Generalized Regional Development Plan
Wilmington, N.C. Area

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PART 4. NORTH ATLANTIC REGION

General Characteristics

Physiographic Description

100. Most of the study area for the North Atlantic Region lies in the Coastal Plain Province of the United States. The Coastal Plain is generally an elevated sea bottom with low topographic relief and extensive marshy tracts. With minor exceptions, most of the Coastal Plain is below 500 feet in elevation with more than half of the area below 100 feet. The plain consists of sedimentary deposits left before the area was elevated above the present shoreline. These formations dip gently seaward and crop out in cuestas and valleys roughly parallel to the inner and outer edges of the plain. The long shoreline of the Coastal Plain consists of sandy beaches and extensive marshlands. The study area for the North Atlantic Region lies in the Embayed Section of the Coastal Plain, a region of drowned valleys and swampy, alluvial flats. The western edge of the study area for the North Atlantic Region lies in the Piedmont Province. The boundary between the Piedmont Province and the Coastal Plain occurs at the Fall Line. This region consists of a rolling upland plateau with occasional isolated mountains. The climate and vegetation of this region are similar to that of the Coastal Plain except that the moderating effect of the ocean is not as pronounced. Forests of the Piedmont Region produce a greater variety of species than is found on the Coastal Plain. The Piedmont Province is largely the result of erosional forces which continue to deliver large volumes of sediment to the coastal areas.

101. Figure 4.1 graphically depicts the coastal study zones for the North Atlantic Region. The contour lines indicate successive distance increments of 25 miles from the ocean or bay shoreline. Therefore, zone "A" represents the area between 0 and 25 miles from the shoreline, zone "B" 25 to 50 miles, etc., up to 100 miles from the coast which is considered to be the approximate practical limit of inland dredged material utilization. Zone "A" or the region represents the major area of urbanization in the region containing all of

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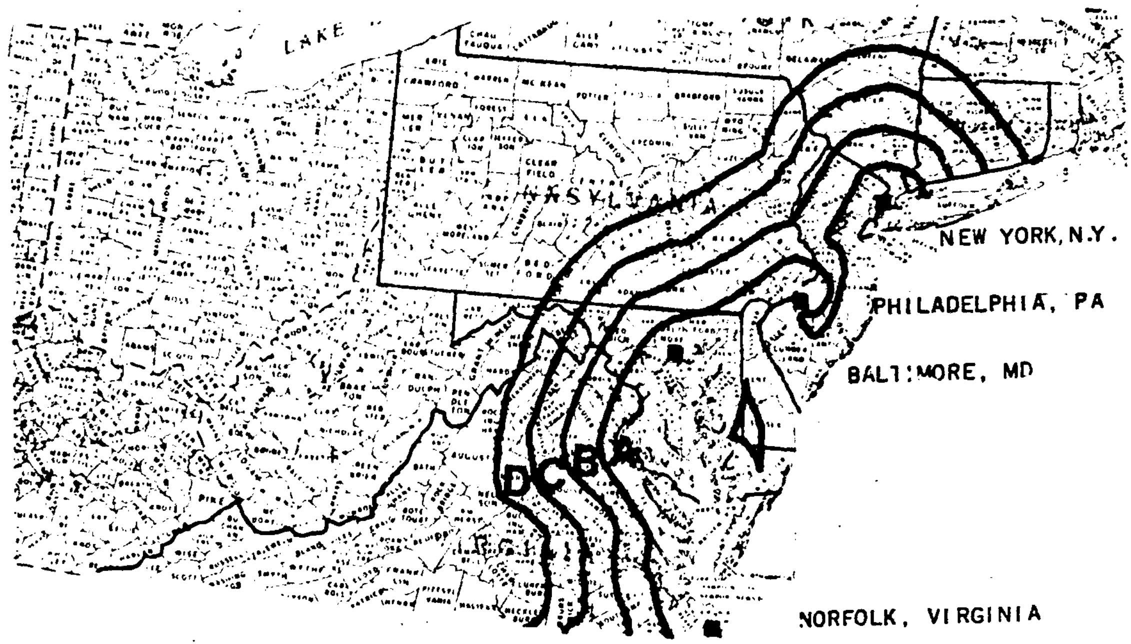


Fig.4.1 Coastal Zones N.Atlantic Region

SCALE 1:7,500,000

■ U.S. ARMY CORPS OF ENGINEERS
DISTRICT OFFICE CITIES

the focal cities of the study area. Zones "B" and "C" consist mainly of croplands together with pasture, woodlands and forests. Zone "D" is made up mostly of an area of ungrazed woodlands and forests. U.S. Army Corps of Engineers Districts include those served by offices at New York, Philadelphia, Baltimore and Norfolk.

Socio-economic profile

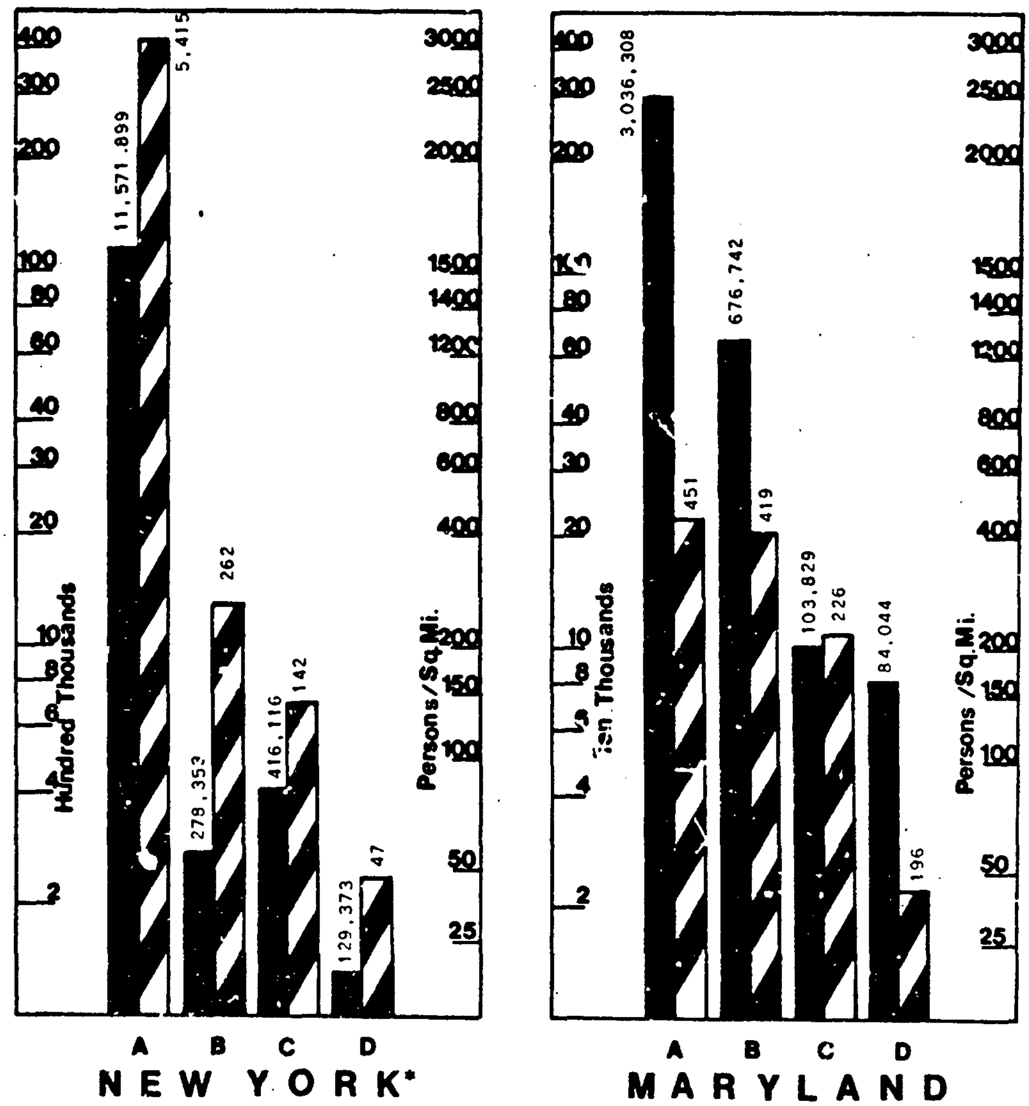
102. Figures 4.2 through 4.4 give population and density figures by state for the coastal study area. Columns "A", "B", "C" and "D" represent the 25 mile increments of distance from the coast. The production statistics given on the following pages represent entire states except for New York and Pennsylvania where a proportional division is made between the North Atlantic and Great Lakes study areas. This information is provided to help establish the essential character of the region under study and to provide background information for the estimation of potential needs for landfill material within the region. Table 4.1 presents selected economic data for the Region.

103. Minerals. Maryland, Virginia, Pennsylvania, and New Jersey each produce between 15 and 25 million short tons of sand and gravel annually. Maryland and Virginia also produce large quantities of building stone and clay for refractory, brick and tile use.

104. Agriculture. The study area for the North Atlantic Region falls into the two broad categories of the Northern Atlantic Slope Truck, Fruit and Poultry Region, and the Northeastern Forage and Forest Region. Chief farm products for the North Atlantic Region include tobacco, corn, soybeans, apples, tomatoes, poultry, dairy products, fish, peanuts, sweet potatoes, vegetables, grain, peaches, pork, and beef.

105. Tourism. The tourist trade constitutes a major industry throughout the North Atlantic Region with many visitors being drawn from home and abroad by the multitude of historic, cultural, and governmental institutions in the area.

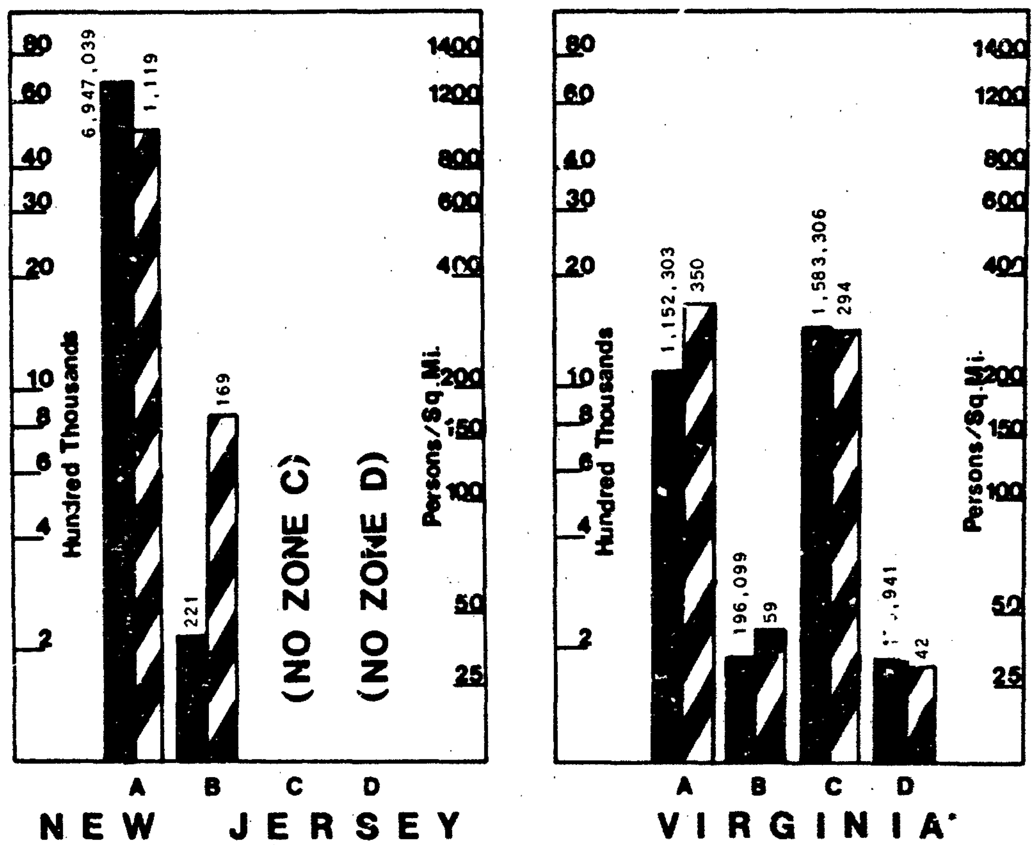
106. Manufacturing. Manufacturing activity in the North Atlantic Region includes a wide variety of products. Chief among these products are: food and kindred products, tobacco, textiles, apparel, lumber and wood products, paper, printing, chemicals, petroleum products, rubber, plastics, leather goods, stone, clay and glass products, primary metals, fabricated metals, machinery, electrical equipment, and transportation products.



*Eastern Counties

LEGEND: Population Density

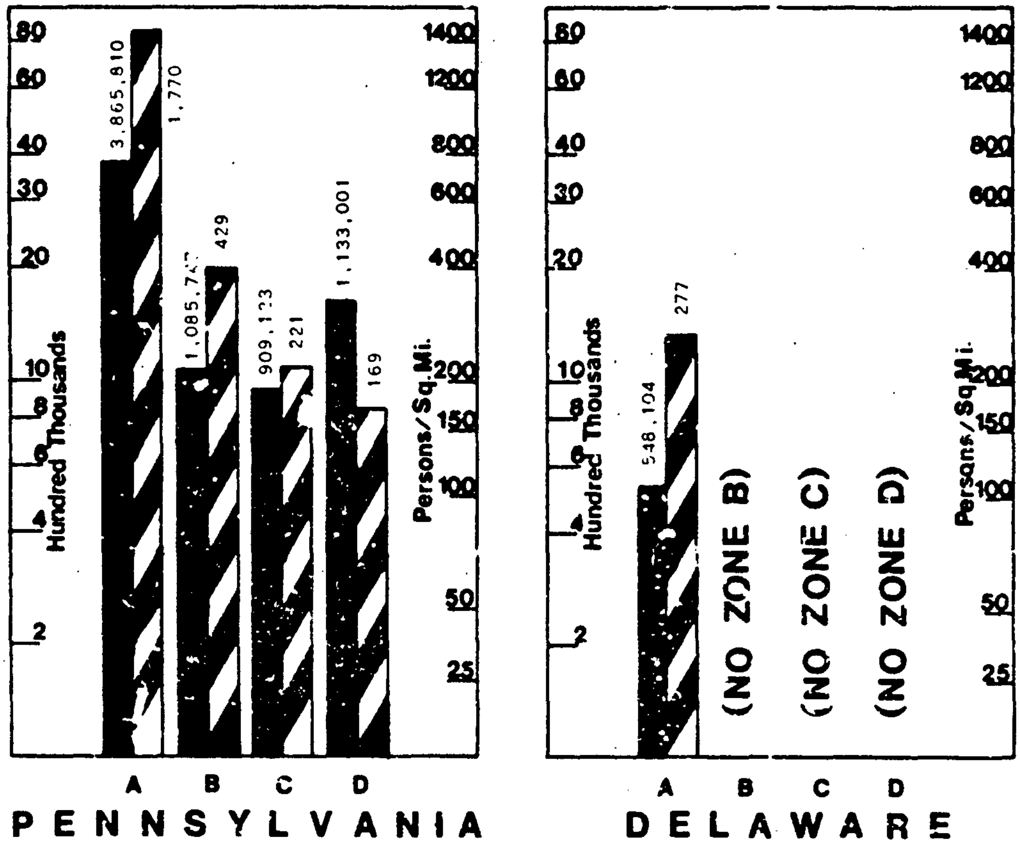
Fig.4.2 Population and Density by Coastal Zone — North Atlantic, N.Y., Md.



* Includes small portion of West Virginia

LEGEND: Population Density

Fig.4.3 Population and Density by Coastal Zone — North Atlantic, N.J., Va.



LEGEND: Population Density

Fig.4.4 Population and Densi' by Coastal Zone — No:th Atlantic,Pa.,De:.

Transportation.

107. The North Atlantic Region is served by an excellent and growing highway system including the greatest concentration of interstate highways in the nation. Included among these interstate systems are routes 64, 95, 66, 81, 83, 76, 80, 87 and 78. In addition to the interstate systems, each major metropolitan area has its own bypasses, beltways and local expressways as well as a pattern of roads radiating from the great metropolitan centers to the residential suburbs. Dozens of railroads operate passenger and freight services throughout the region with major rail corridors existing between the large urban centers. Many of the nation's largest airports are located around the large metropolitan areas. There is also extensive coastal shipping carried on between the major ports by way of the Atlantic Ocean and the Chesapeake and Delaware Canal.

Existing development trends

108. There are 16 Standard Metropolitan Statistical Areas (SMSA's) in this region within the 100 mile belt defining the coastal study area. The growth trends analysis is made on the general characteristics of this SMSA data and various regional planning reports. The North Atlantic Region experienced a rapid population and economic expansion in the first half of this century. Future population settlement will continue to develop on the coastal and central corridor portions of the region. For the region as a whole, new residential developments are being planned in compact and contiguous clusters to take maximum advantage of public facilities and services. Jersey City, N.J., is the only SMSA in the region that experienced a decline in both population and migration, while other areas in the Region experienced gains of from 8.2% to 37.8%. Jersey City has reached 100% urbanization the the resulting saturation of services and facilities may be one reason for its decline in population. An interpretation of available data indicates that growth and development will continue in the region, but the ultimate density pattern and distribution will shift toward the outer areas to establish a stable level of development. Throughout the region measures are being taken to conserve most of the natural features in marshy areas and flood plains.

Regardless of the expected increased urbanization throughout the Region, extensive portions below Washington, D.C., throughout Maryland and Virginia, and the southern portions of New Jersey and Delaware will remain undeveloped at the coming turn of the century.

Availability of Dredged Material

Supply

109. The focal cities and Corps of Engineers service districts in this region are listed in Table 4.2 with their annual volume of dredged material. Table 4.3 shows the location of this material within the District, and Table 4.4 gives the general nature of the material.

Demand

110. Awareness of Availability. In nearly all cases, in the four districts surveyed, port authorities, state agencies, planning groups, chambers of commerce, etc., were aware of the possibilities of using dredged material as a landfill material. This fact was particularly true in the coastal areas. When sources further inland were contacted, fewer actual considerations of dredged fills were reported. Many sources indicated an awareness of the quantities of material involved and the general nature of the material in their areas.

111. General Requests for Material. Occasionally private sources approach Corps District Offices seeking fill material. These requests must usually be turned down, however, due to transportation and access problems to the proposed sites of deposition and also because these requests rarely involve significant quantities of material. An exception to this situation is the Philadelphia District where large quantities of dredged material are sold each year to public and private buyers to be used as fill material. Some sales of dredged material for fill have also been reported at Craney Island Dike in Norfolk Harbor.

Limitations affecting use of dredged material

112. Economics. Dredged material has been successfully pumped and deposited as hydraulic fill in many applications throughout the North Atlantic Region. These successful applications occur in the immediate coastal area, however, a frequently suggested alternative disposal scheme in this region is the filling of strip mines. This idea would require long

distance pipelining of the material to points 100 miles or more away from the center of dredging activity. The highly urbanized character of the North Atlantic Region and the change in physiography to a more rugged terrain as one leaves the coastal plain all but preclude this scheme as a feasible method of transporting dredged material. It is possible that barging of dredged material could be accomplished to some inland points by way of the navigable rivers of the North Atlantic Region. It is doubtful that dredged material can compete with commercial borrow operations outside the immediate coastal area. Within the coastal area dredged material continues to be an economical solution to massive fill requirements encountered in airport, industrial and artificial island construction.

113. Quality. Generally speaking, materials that are coarse grained are not difficult to dispose of. These materials have had much application in filling and beach nourishment operations throughout the North Atlantic Region. The finer materials composed of clay and silt are more difficult to dispose of, since they make poor foundation materials and are not suitable for erosion control due to their own inherent high erodability. Other limitations to the use of these materials are high pollution levels from municipal and industrial wastes, and the salinity of the material. Material encountered in the North Atlantic Region consists mostly of mixtures of silts and fine sands that make good landfill materials, provided advance planning can provide the necessary time for dewatering and consolidation. Another frequently mentioned drawback to the use of dredged material as landfill is the long consolidation time required before the land created can be used for even moderately heavy structures due to the extremely high water content of the material. A possible exception to the water content problem associated with dredged fill is the proposal to fill over large sanitary landfills in the Hackensack Meadowlands area of New Jersey. The developers of this area are not only seeking an inexpensive fill material to develop the vast area involved, but are also impressed with the possible beneficial effect of the high water content in lessening the hazard of fires in the sanitary landfill material.

114. Environmental Constraints. The fears of Environmental Groups and wildlife protective organizations in both the public and private sectors are based on environmental changes that might occur due to removal of material and deposition of material. Of these

two types of changes, much stronger opposition results to the deposition phase than to the removal phase.[4.2] With regard to the location of confined disposal areas at offshore sites, chief objections are, possible smothering of benthic organisms, encroachment on fish spawning areas, creation of suspended sediment loads in areas near construction sites, eventual water pollution from polluted material seeping through diked enclosures, production of noxious odors and mosquito colonies, disruption of natural waterflow patterns, and possible creation of navigational hazards to small boats. Additional fears are sometimes indirectly attached to confined area construction. These include objections to noise, heavy equipment traffic, etc., associated with construction, and fears that completed containment areas will breach from storm damage and release pollutants to nearby waters.[4.3.] Objections to disposal on wetlands areas include possible turbidity and pollutant runoff into adjacent estuarine waters which may necessitate closing of shellfish and recreational areas nearby, frequently areas of shallow water and limited circulation. Many object to disposal in these areas because of possible nutrient enrichment of shallow water areas that results in dense algal blooms.[4.2.] Throughout the North Atlantic Region opposition to dredging and landfill projects can be expected to come chiefly from the following sources: commercial shellfishermen, boating, fishing and hunting groups, associated interests such as marine suppliers and sporting gooods dealers, area residents, local, state and federal government agencies, and the loosely defined but growing group of civic, improvement, and conservationist organizations.

115. Other Limitations. Other constraints that exist to the placement of dredged material in landfill sites in the North Atlantic Region can best be described as psychological constraints. In many areas there are individuals and groups, particularly area residents, who are afraid that landfill sites scheduled for use as parklands or wildlife areas will in fact become expansion sites for politically powerful local industries. In spite of reassurances from local governments and zoning boards, these views persist. There is also a great aversion in some inland areas to accepting a fill material coming from outside the area. This feeling is

particularly strong in the northeastern section of Pennsylvania where strong opposition is met by advocates of dredge or solid waste disposal on the premise that this material is "Philadelphia's garbage" In the eyes of local people, acceptance of these materials degrades their area to the status of a dumping ground. This attitude is undoubtedly due to unpleasant experiences in the past. An education and demonstration program may be necessary in these areas before local acceptance can be obtained.

Regional Landfills

Sampling of Landfill Projects

116. Matrix 4A presents a regional inventory of reported landfill projects both existing and proposed. These projects are those described in reports, literature and personal interviews as well as in letters and telephone conversations with government agencies, planning groups, port authorities, Corps District Offices, chambers of commerce and other interested individuals and groups throughout the region. Matrix 4A presents these reported projects in a form showing location of dredged material usage with respect to the 25 mile incremental distance bands indicated by the lettered columns. The numerals 1, 2 and 3, indicate suggested, proposed and existing usages respectively. Tables 4.5 through 4.8 present brief descriptions for a sampling of projects for each focal city within the Region. Supplemental data, including more detailed project descriptions and copies of actual letters received, may be found in the Appendix. Figure 4.5 summarizes in graphic form the information of Matrix 4A.

Example projects

117. Many examples of dredged fill applications for various phases of development exist throughout the North atlantic Region. Most of these projects arose out of a need for readily accessible fill near coastal areas rather than from any need to dispose of dredgings. In much earlier times, large portions of the southern section of Baltimore City were reclaimed from the swampy area surrounding the Northwest Branch of the Patapsco River.[4.8] Somewhat more recently, part of the sites of Washington National Airport and Philadelphia Airport are on dredged fill. Since 1947, the Bethlehem Steel Company has

MATRIX 4A

SAMPLING OF LANDFILL PROJECTS			USACE DISTRICTS - COASTAL ZONES															
			BALTIMORE				NEW YORK				PHILADELPHIA				NORFOLK			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	3	2	1	3	2	2	2	1	2	2	-	2	3	3	-	-
		COMMERCIAL	1	2	1	1	1	1	1	1	2	2	-	2	1	1	-	-
		RESORTS; COMMERCIAL CAMPS	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
		COMMUNITY FACILITIES	2	-	-	-	1	1	-	-	-	-	-	2	-	-	-	-
		MEAN	2.0	1.0	0.5	1.5	2.3	2.3	0.8	0.5	1.0	1.0	0	1.5	1.3	1.0	0	0
	ECONOMIC	INDUSTRIAL	3	3	-	-	1	2	-	-	3	3	2	2	-	-	-	-
		RAIL; RAPID TRANSIT	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
		AIRPORTS	-	1	2	-	-	2	2	-	1	-	-	2	-	-	-	-
		HARBORS; PORTS	3	2	3	-	-	3	2	-	-	-	2	-	3	-	-	-
		HIGHWAYS	-	-	-	-	2	2	1	1	-	2	1	-	1	1	1	1
		UTILITIES	-	-	-	-	-	-	[illegible]	[illegible]	1	-	-	-	-	-	-	-
		MEAN	1.2	1.3	0.9	0	0.5	1.3	0.8	0.3	1.5	0.8	0.8	0.7	0.7	0.2	0.2	0.2
	ENVIRONMENTAL	WILDLIFE REFUGES; ROOKERIES	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-
		MARINE NURSERIES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BEACH NOURISHMENT	-	-	-	3	3	3	2	2	-	2	2	-	-	2	2	-
		PARKS & RECREATION: PUBLIC*	2	2	-	-	2	2	3	-	2	2	2	2	2	2	2	-
		MARSHLAND MANAGEMENT	-	-	-	3	2	2	2	-	-	2	2	-	1	1	1	-
		SANITARY LANDFILLS	-	-	-	-	2	2	2	2	2	2	-	2	2	2	2	2
		OTHER LANDFILLS	2	2	2	1	-	1	1	1	2	2	2	2	-	2	2	2
		FLOOD PLAIN CONTROLS/LEVEES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MEAN	0.5	0.5	0.3	1.3	1.1	1.3	1.3	0.5	0.9	1.3	1.0	0.8	0.6	1.1	1.1	0.5
	RESOURCE	ARTIFICIAL ISLANDS	2	-	-	3	2	2	2	-	-	3	2	-	2	-	-	-
		AGRICULTURAL/GRAZING LAND	2	2	-	-	-	-	-	-	-	1	2	2	2	1	1	-
		FORESTRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BRICK MFG.; CERAMICS, ETC.	-	-	2	-	1	1	2	-	1	-	-	-	-	-	-	-
		LAND RECLAMATION	2	2	2	1	-	-	-	-	1	1	1	-	[illegible]	2	2	1
		SAND & GRAVEL	1	-	1	-	3	3	3	-	3	3	1	-	-	3	3	-
		MATERIAL STOCKPILES	2	-	-	-	-	-	-	-	1	-	1	1	-	1	1	-
		MEAN	1.1	0.5	0.6	0.8	0.8	0.8	0.8	0	1.1	1.3	1.1	0.8	0.8	1.1	1.1	0.3
	MEAN VALUES		1.2	0.8	0.6	0.9	1.2	1.4	0.9	0.4	1.1	1.1	0.7	0.9	0.9	0.9	0.6	0.2

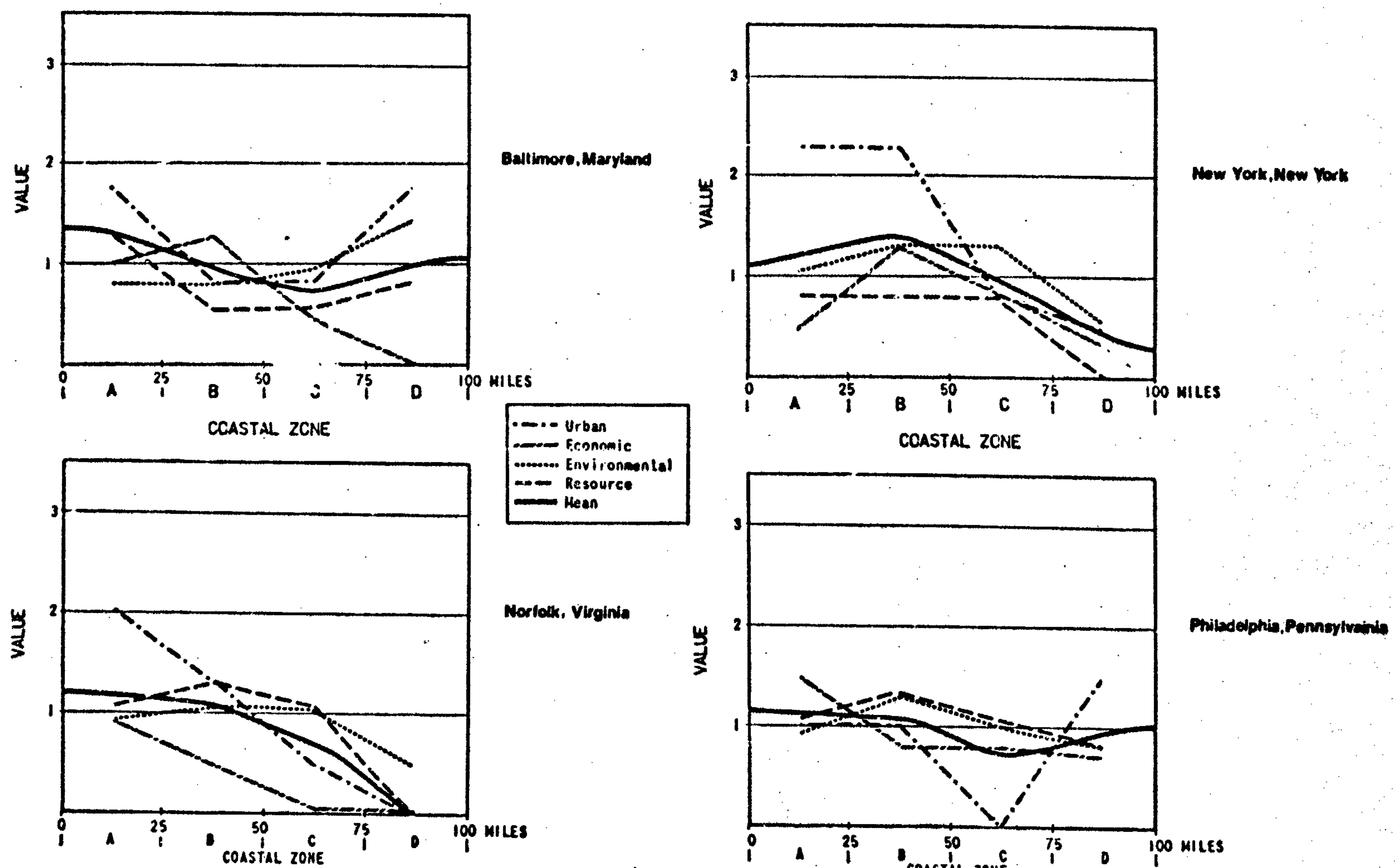


Fig A.5 Existing Landfill Projects
MATRIX 4A

added approximately 500 acres to their Sparrows Point Plant at Baltimore by filling in areas of the Patapsco and nearby swampy areas. Much of this filling was done with dredged material. An example of a completely planned approach to dredged material disposal can be seen in the Craney Island Project in Norfolk Harbor. Craney Island is a 2,500 acre diked disposal area capable of containing approximately 100,000,000 cubic yards of dredged material situated at an undeveloped waterfront area. This diked disposal area is scheduled to be filled by 1978. Planning done for the area by Division of State Planning and Community Affairs, Commonwealth of Virginia indicates future planned use for industrial and port facilities development together with either an airport or commercial and residential development. Both plans also include open space recreation areas. Another current constructive use of substantial amounts of dredged material is the direct sale by Philadelphia District, USACE of dredgings as fill material. In fiscal year 1973, these sales amounted to $223,350 for 925,000 cubic yards of material.

118. Several interesting projects are proposed for the North Atlantic Region which, if implimented, will contribute substantially to the solution of dredged material disposal problems in the Region. One of these projects is a large "Superport" constructed in Delaware Bay to facilitate offshore unloading of oil tankers. Included in the proposed development are recreational and small boating facilities. The major area of interest, located four miles offshore on the causeway leading to "Superport", features a 500 acre island providing space for townhouse and condominium development, motels, an amusement park and recreational areas. This proposed island would require 30,000,000 cubic yards of dredged fill. For a plan of this proposed development, see Figure 4.6. The petroleum industry is enthusiastic about such a "Superport" claiming it would facilitate pollution free oil tanker unloading. Others feel that the proposal would generate heavy industrial development in coastland areas. Another proposed project is the Hart-Miller Islands Diked Disposal Area in Chesapeake Bay near Baltimore. This project consists of an 1140 acre artificial island to be built with 100,000,000 cubic yards of dredged material from Baltimore Harbor and its approach channels. Development of a large recreational complex in

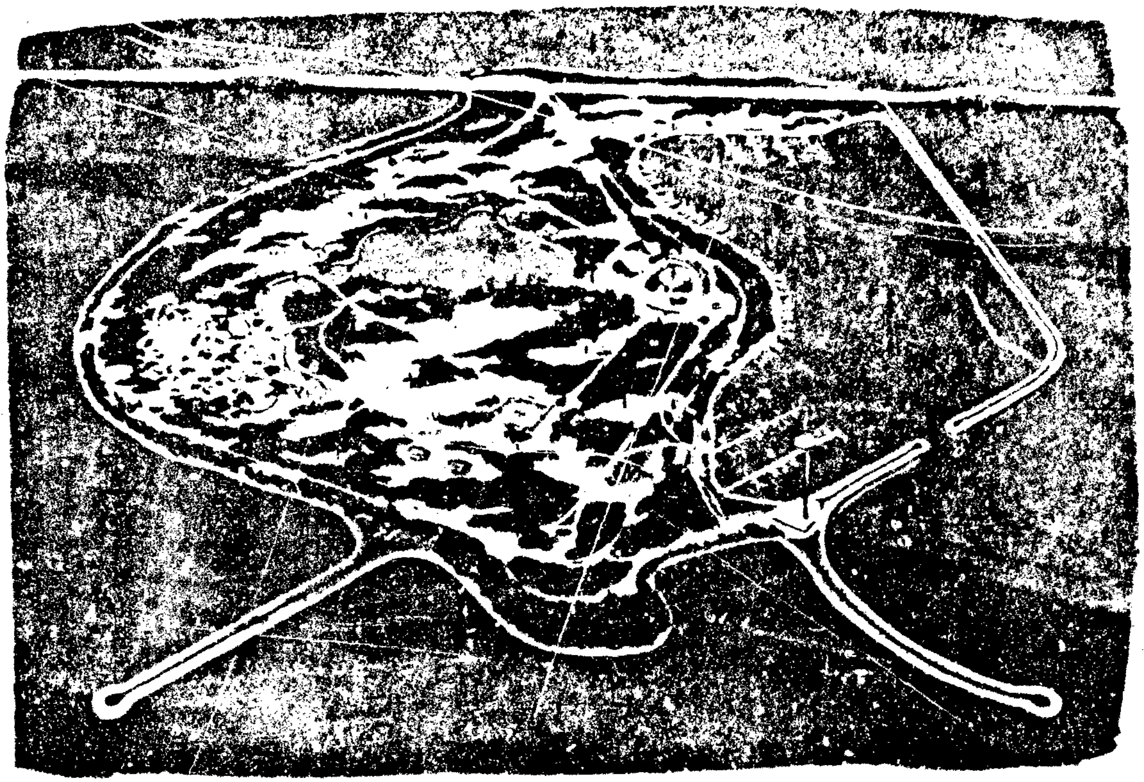


Fig.4.6 Proposed Delaware Bay Superport

keeping with the surrounding land use is the eventual goal of this project as shown on Figure 4.7. This project is currently undergoing detailed analysis by concerned groups with regard to possible environmental consequences to Chesapeake Bay and answers are being provided for the many questions raised concerning local impact and future development of the island. Many other currently proposed projects are recorded in Matrix 4A and Tables 4.5 through 4.8.

Potential Landfill Projects.

119. Matrix 4B presents an inventory of potential landfill usage shown by distance from the focal city under consideration. These potentials are based largely on the premise that future dredged material fills can most likely be developed in areas and in situations where they have been utilized in the past. Also included in lists of potential usages are suggestions made by the sources contacted during the study which have not yet come to the status of a proposed use. Once again the lettered columns indicate distance form the principal source of dredging at the focal city. The numbers 1, 2 and 3 in Matrix 4B indicate least, moderate and greatest potential. Matrix 4C shows a quantitative assessment based on the potential usages of Matrix 4B. In Matrix 4C, the numbers 1, 2 and 3 serve to indicate relative estimated quantities of material usable in the particular application according to the following scale:

1 - less than 500,000 cubic yards
2 - between 500,000 and 2,500,000 cubic yards
3 - over 2,500,000 cubic yards

All of the information presented in Matrices 4B and 4C is summarized in graphic form in Figures 4.8 and 4.9. As indicated by the graphs for the various Corps District cities, potential usage is highest near the coastal areas and generally falls off sharply as distance from the coast increases.

Fig.4.7 Proposed Recreational Development

MATRIX 4B

		POTENTIAL LANDFILL PROJECTS	USACE DISTRICTS - COASTAL ZONES															
			BALTIMORE				NEW YORK				PHILADELPHIA				NORFOLK			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL: HOUSING	3	1	1	1	3	3	2	1	2	2	1	2	3	3	1	-
		COMMERCIAL	3	1	1	3	3	3	1	1	2	2	1	2	2	3	1	-
		RESORTS: COMMERCIAL CAMPS	-	-	-	-	-	-	-	-	-	-	-	[illegible]	2	1	-	-
		COMMUNITY FACILITIES	2	1	1	1	3	3	1	1	1	1	1	2	-	-	-	-
		MEAN	2.0	08	08	18	23	2.3	10	08	13	1.3	08	.5	20	13	05	0
	ECONOMIC	INDUSTRIAL	3	3	-	-	1	1	1	-	3	3	2	2	1	1	-	-
		RAIL: RAPID TRANSIT	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		AIRPORTS	-	1	-	-	2	2	1	1	1	-	-	2	-	-	-	-
		HARBORS: PORTS	3	2	1	-	1	1	2	1	1	-	2	-	1	1	-	-
		HIGHWAYS	1	1	-	-	2	[illegible]	1	1	1	2	[illegible]	1	1	1	1	1
		UTILITIES	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
		MEAN	10	11	04	0	08	1.0	08	05	14	05	06	06	08	15	11	[illegible]
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
		MARINE NURSERIES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BEACH NOURISHMENT	1	1	1	1	1	1	2	2	1	2	2	1	1	2	2	2
		PARKS & RECREATION: PUBLIC	2	2	1	1	2	2	2	1	2	2	2	2	2	2	2	2
		MARSHLAND MANAGEMENT	1	1	1	3	2	2	2	-	-	2	2	-	1	1	1	1
		SANITARY LANDFILLS	-	-	-	-	2	2	2	2	2	2	1	2	2	2	2	2
		OTHER LANDFILLS	2	2	2	1	1	1	1	1	2	2	2	2	1	2	2	2
		FLOOD PLAIN CONTROLS/LEVEES	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-
		MEAN	08	08	09	14	13	13	14	09	10	13	13	1.0	09	1	11	05
	RESOURCE	ARTIFICIAL ISLANDS	2	-	-	1	2	2	2	-	1	1	2	-	2	1	[illegible]	-
		AGRICULTURAL/GRAZING LAND	2	2	-	-	-	-	-	-	-	-	2	2	2	1	1	-
		FORESTRY	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
		BRICK MFG.: CERAMICS, ETC.	1	1	2	-	1	1	2	1	1	-	-	-	1	-	-	-
		LAND RECLAMATION	2	2	2	3	-	-	-	-	3	3	3	1	2	2	2	-
		SAND & GRAVEL	1	-	1	-	1	3	3	[illegible]	1	3	-	-	1	1	[illegible]	-
		MATERIAL STOCKPILES	2	-	-	-	-	-	-	-	1	1	3	3	1	3	2	-
		MEAN	13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13	13	[illegible]	[illegible]	11	[illegible]	[illegible]	[illegible]
		MEAN VALUES	13	09	07	10	13	15	10	06	10	11	09	10	12	11	[illegible]	[illegible]

MATRIX 4C

QUANTITATIVE ASSESSMENT		USACE DISTRICTS - COASTAL ZONES															
		BALTIMORE				NEW YORK				PHILADELPHIA				NORFOLK			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS — URBAN	RESIDENTIAL; HOUSING	3	2	1	2	2	2	2	1	2	2	1	2	2	2	1	-
	COMMERCIAL	3	2	1	3	2	2	1	1	2	2	1	2	2	2	1	-
	RESORTS: COMMERCIAL CAMPS	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-
	COMMUNITY FACILITIES	1	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
	MEAN	1.8	1.3	0.8	1.5	1.3	1.3	1.0	0.8	1.3	1.3	0.8	1.3	1.8	1.8	0.5	0
ECONOMIC	INDUSTRIAL	3	2	-	-	1	1	1	-	2	2	2	2	2	2	-	-
	RAIL: RAPID TRANSIT	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AIRPORTS	-	2	-	-	2	2	1	1	1	-	-	2	-	-	-	-
	HARBORS: PORTS	3	1	1	-	2	1	1	1	2	-	3	-	3	3	-	-
	HIGHWAYS	1	1	-	-	2	2	1	1	1	1	2	1	1	1	1	1
	UTILITIES	-	-	-	-	-	-	2	2	2	-	-	-	1	1	-	-
	MEAN	1.0	0.9	0.1	0	0.9	0.8	0.8	0.6	1.3	0.4	0.5	0.6	0.9	0.9	0.1	0.1
ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	-	-	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-	-	-	-	-
	MARINE NURSERIES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BEACH NOURISHMENT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	PARKS & RECREATION: PUBLIC	3	2	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	MARSHLAND MANAGEMENT	1	1	1	1	2	2	2	-	-	1	-	-	1	1	1	-
	SANITARY LANDFILLS	-	-	-	-	2	2	2	2	1	1	1	1	1	1	1	1
	OTHER LANDFILLS	3	3	2	1	3	3	3	3	2	2	2	2	1	1	1	1
	FLOOD PLAIN CONTROLS/LEVEES	-	-	-	-	-	-	2	2	-	-	2	2	-	-	-	-
	MEAN	1.0	0.9	0.8	0.6	1.3	1.3	1.5	1.3	0.8	0.9	1.1	1.0	0.8	.8	0.8	0.3
RESOURCE	ARTIFICIAL ISLANDS	3	-	-	2	3	3	3	-	3	3	3	-	3	3	-	-
	AGRICULTURAL/GRAZING LAND	1	1	-	-	-	-	-	-	-	-	1	1	1	1	1	-
	FORESTRY	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-
	BRICK MFG.: CERAMICS, ETC.	1	1	1	-	2	2	2	2	1	-	-	-	1	-	-	-
	LAND RECLAMATION	2	2	2	1	-	-	-	-	2	2	2	2	2	2	2	2
	SAND & GRAVEL	1	-	1	-	3	3	3	3	2	2	-	-	1	1	1	-
	MATERIAL STOCKPILES	2	-	-	-	-	-	-	-	2	2	2	2	2	2	2	2
	MEAN	1.3	0.5	0.5	0.4	1.0	1.0	1.0	0.6	1.4	1.1	0.6	0.8	1.3	1.3	0.8	0
MEAN VALUES		1.3	0.9	0.6	0.6	1.1	1.1	[illegible]	0.8	1.2	0.9	0.8	0.9	1.2	1.2	0.6	0.1

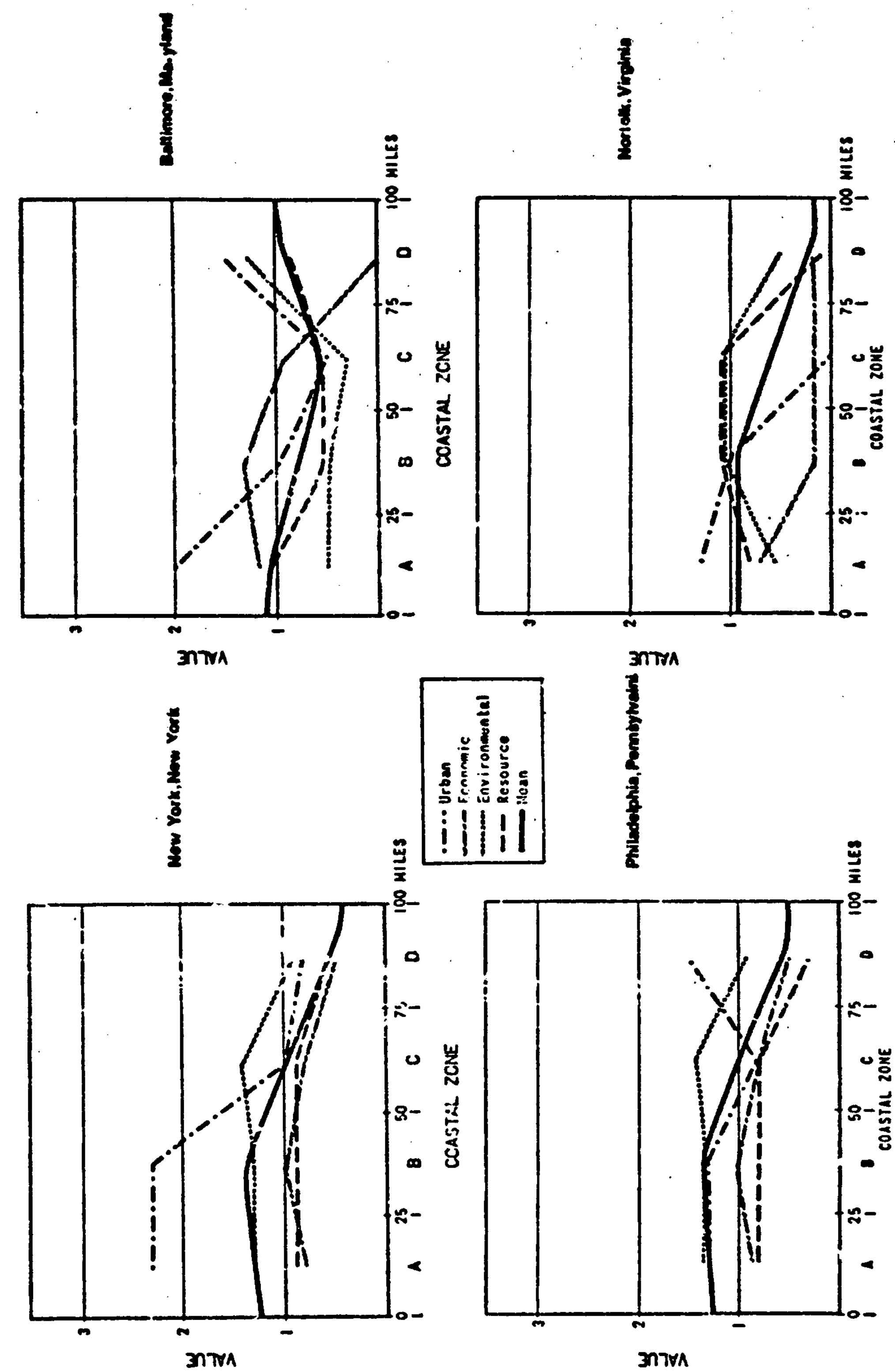


Fig.4.8 Potential Landfill Projects:
MATRIX 4B

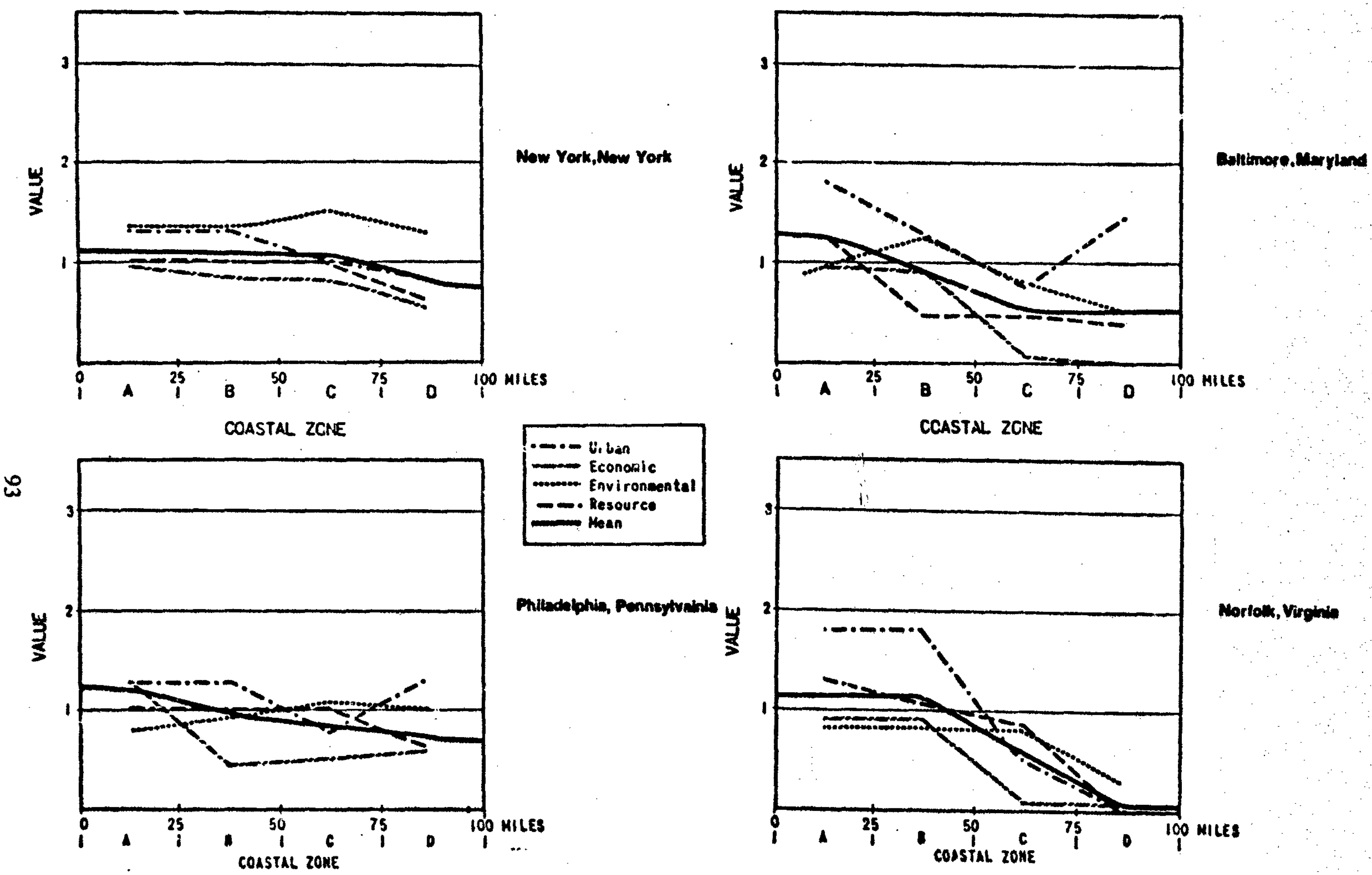


Fig.4.9 Quantitative Assessment
MATRIX 4C

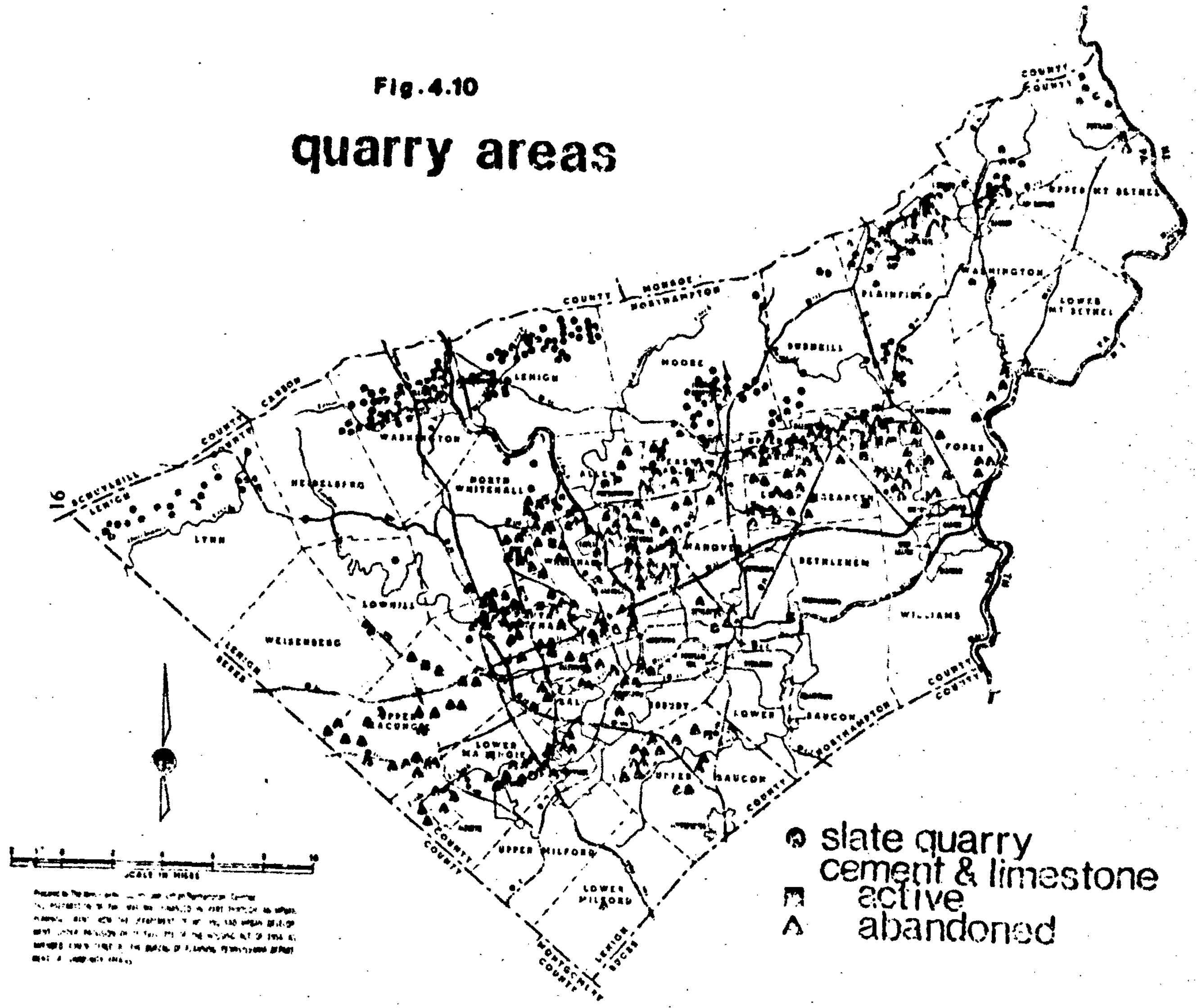
Assessment of Potentials and Needs

120. During the research for this report, sources contacted suggested many uses for dredged material. In the North Atlantic Region the most frequently suggested usage was that of fill for strip mined areas of Pennsylvania, Maryland and Virginia. Included as Figure 4.10 is a map of surface mine locations supplied by the Joint Planning Commission of Lehigh–Northampton Counties, Pennsylvania. This agency has suggested reclaiming the inactive sites with dredged material. An estimate of the quantity of material needed is not available. Also among the most frequently suggested uses is use as cover material for sanitary landfill operations. Responses from many areas indicate a general lack of landfill cover material, particularly in urbanized areas. Many development agencies contacted expressed concern over the lack of an economical fill material for development of residential and commercial complexes. State highway administrations expressed some interest in dredged material use in highway embankments but many were concerned about the problems associated with dredged fill material in its unprocessed state. Several sources in Virginia suggested development of existing marshes near the mouth of the James River. Flood control dikes and other protective structures are also needed in this area.

121. One interesting proposal put forth by the Economic Development Council of Northeastern Pennsylvania and the Laredo group at Mount Carmel, Pennsylvania involves the disposal of dredgings with mine culm. For years attempts have been made to use the enormous banks of mine culm prevalent throughout the region for some beneficial purpose, ideally as back fill for extensively strip mined areas. The problem is that this culm cannot sustain vegetative growth of any kind. The organizations mentioned above have proposed mixing this material with nutrient-rich dredged material to produce a fill material more conducive to growth. In their view this material might have possible agricultural uses as well as potential as fill. Other potential usages may be found listed in Matrix 4B.

Fig. 4.10

quarry areas



Sample of future land use and development plans.

122. Several major areas of potential for use of dredged landfill material have been identified in the North Atlantic Region. The three potential future use areas described in this section are presented as being typical of potential for this Region.

123. The City of Baltimore is currently involved in a major redevelopment and change of emphasis for its inner harbor area. This redevelopment could involve a substantial need for dredged fill material to facilitate new development throughout the port area. The following statement is excerpted from the Baltimore Regional Planning Council's, *An Evaluation of Baltimore Harbor Land Use Potentials* released in February, 1973.

> "The U.S. Army Corps of Engineers will in the next few years embark upon a program of channel deepening from the mouth of the Cheseapeake to the Northwest Branch and Ferry Bar in Baltimore Harbor. The spoil resulting from this dredging, and that resulting from subsequent maintenance dredging operations, could be judiciously utilized in expanding present Harbor shoreline when properly mixed with other fill materials, and at points where this extension will further the land use potential and the attractiveness of the Harbor's edge. Bulk-heading and diking should effectively restrict seepage from contained spoil which might contaminate and pollute open waters beyond the fill site. The engineering and design of the dikes should reflect predetermined land use plans so as to achieve optimal shoreline development objectives."

In the plan for this proposed redevelopment scheme contained in the report cited above, several areas of proposed fill are identified as follows:

a. A Harbor - encircling causeway connecting points of major interest.

b. Shoreline landscaping of undeveloped land around the Harbor's perimeter.

c. Filling to facilitate construction of the planned Hawkins Point Marine Terminal.

d. An industrial park in the Fairfield area.

e. A dredge and fill park on the Masonville tract.

f. Filling of the upper Middle Branch of the Patapsco River for commercial development.

g. Filling along Boston St. shoreline out to the bulkhead line.

h. Filling of portions of Lazaretto Point to develop a shoreline park.

i. Sea Girt Terminal.

j. Further filling at Dundalk Marine Terminal.

k. Filling Sollers Point out to the bulkhead line to create a public access area.

l. Filling of Humphrey Creek for industrial expansion.

In addition to these identified major use areas, there are numerous sites planned for commercial, residential, civic and industrial development that will require fill. These potential fill developments are identified by their letters as given above on the accompanying map shown as Figure 4.11.

124. Another major identified area of potential use is the Hackensack–Meadowlands area of eastern New Jersey. This area of approximately 20,000 acres of land borders both sides of the Hackensack River between Hackensack and Jersey City, New Jersey. The physical make-up of the area is predominantly meadow mat and organic silt. The district is low lying and is frequently subject to tidal inundation and fresh water flooding. These conditions have made development in the Meadowlands a difficult and costly proposition. About one-third of the area is currently developed with roads, rail lines, airports, freight terminals, warehouses, transmission lines, storage tanks and roadside service areas. Landfills in the Meadows currently absorb 42,000 tons of refuse each week from more than 100 surrounding municipalities further complicating beneficial development of the land. The Meadowlands are currently under the direction of the Hackensack Meadowlands Development Commission, a State agency empowered to develop a master plan for the area and then implement that plan. Of chief concern to the Commission at the moment is the problem of securing an economical fill material to allow development of the extensive inactive sanitary landfill sites within their project area. Great problems are being

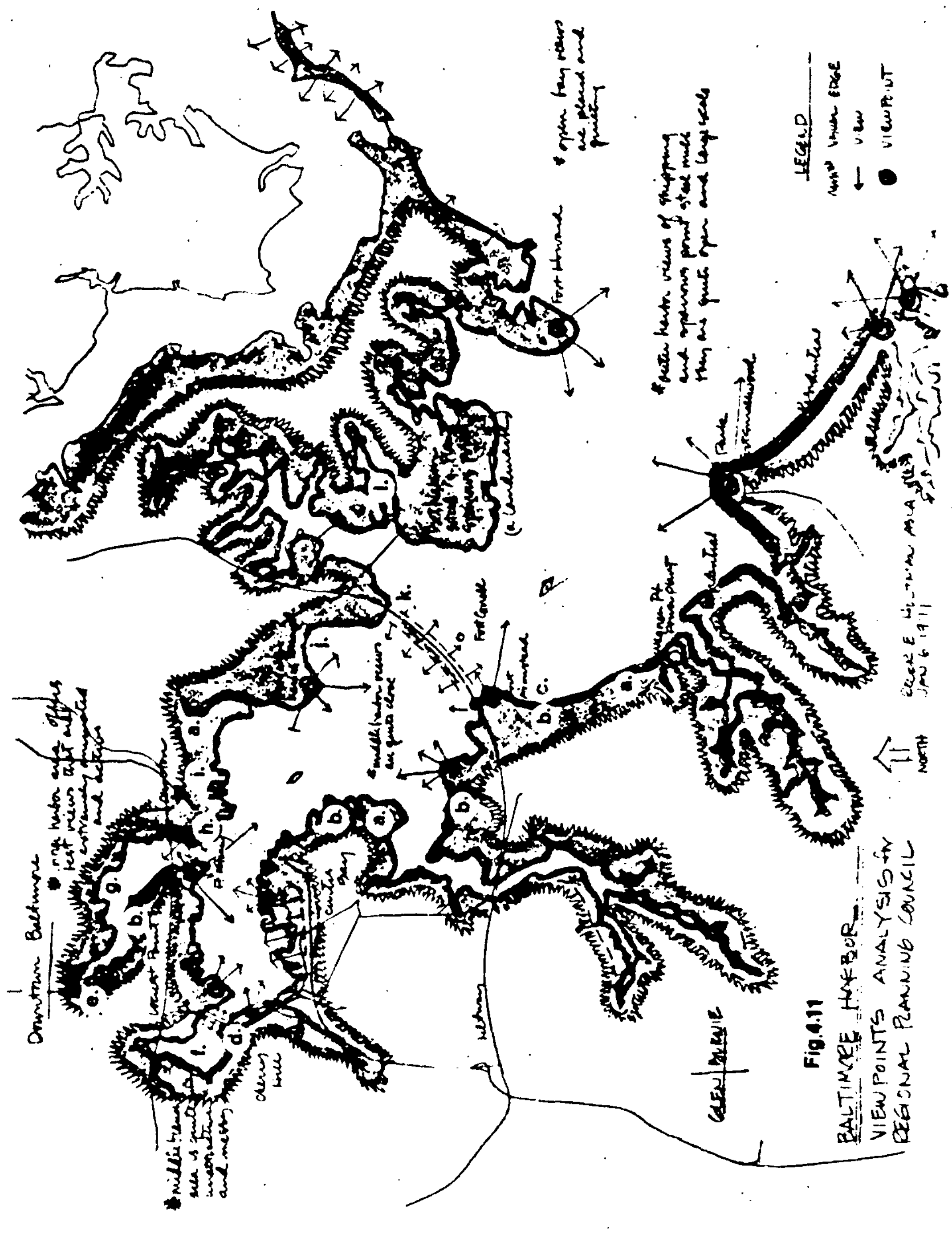


Fig.4.11 BALTIMORE HARBOR VIEWPOINTS ANALYSIS
REGIONAL PLANNING COUNCIL

encountered by the Commission in preventing fires in the active and inactive landfill sites. Recently the Commission has expressed an interest in exploring the use of dredged material in developing the landfill sites. Figure 4.12 is a plan of inactive (shaded areas) sanitary landfills and active (dotted areas) landfill operations prepared for the Hackensack Meadowlands Development Commission. Figure 4.13 is a plan of the inactive sites, or potential development sites, projected onto a U.S. Geological Survey map of the area. Each potential site is marked with a symbol identifying its intended future land use as delineated on the Development Commission's Master Plan. About 2800 acres of inactive landfill sites are available at this time. Conservatively assuming that these areas would be raised 6 feet above their present level, a need is generated for 27 million cubic yards of material with no allowances made for initial settlement. Looking beyond this imminent need for fill material, full utilization of the undeveloped lands of the Meadows is expected to take 30 years. During this time additional demands for fill material will be continuing concern. Utilization of dredged material in this application will supply the means to develop a much needed tract of land adjacent to one of the world's largest population centers to correct existing imbalances in regional land use.

125. The third example of an identified potential use area is the planned development of the Delaware Valley of Pennsylvania and New Jersey. The Delaware Valley Regional Planning Commission's Land Use Plan represents a general idea of how available land in the Philadelphia area might best be used in 1985 through suggestions on how future growth can be advantageously combined with existing facilities. Figure 4.14 shows the Commission's suggested future land use scheme projected onto a U.S. Geological Survey map of the Philadelphia area. The overlay to this figure shows the location of potential landfill areas as identified during the research phase of this study. These locations are those suggested by planning agencies, chambers of commerce, port authorities, etc. Those areas identified with the "CE" designation are Corps disposal sites. After these sites are filled, the option remains to continue using them by offering the contained material for sale, or to permit development on the sites. The quantities of material involved in developing the

potential sites are also shown on Figure 4.14. The dotted areas shown on this figure are low-lying swampy areas intended to be held as conservation areas.


SITE
SEACAUCUS
SEACAUCUS

Fig. 4.12
HACKENSACK MEADOWLANDS

SYMBOL	DEVELOPMENT	AREA	NEEDED FILL*
U	URBAN	929	9.0 MIL. CU. YDS.
Ec	ECONOMIC	1730	16.8 MIL. CU. YDS.
En	ENVIRONMENTAL	158	1.5 MIL. CU. YDS.
R	RESOURCE		-

*FILL AT ASSUMED DEPTH OF 6 FEET.

Fig. 4.13 Hackensack Meadowlands Generalized Development Plan

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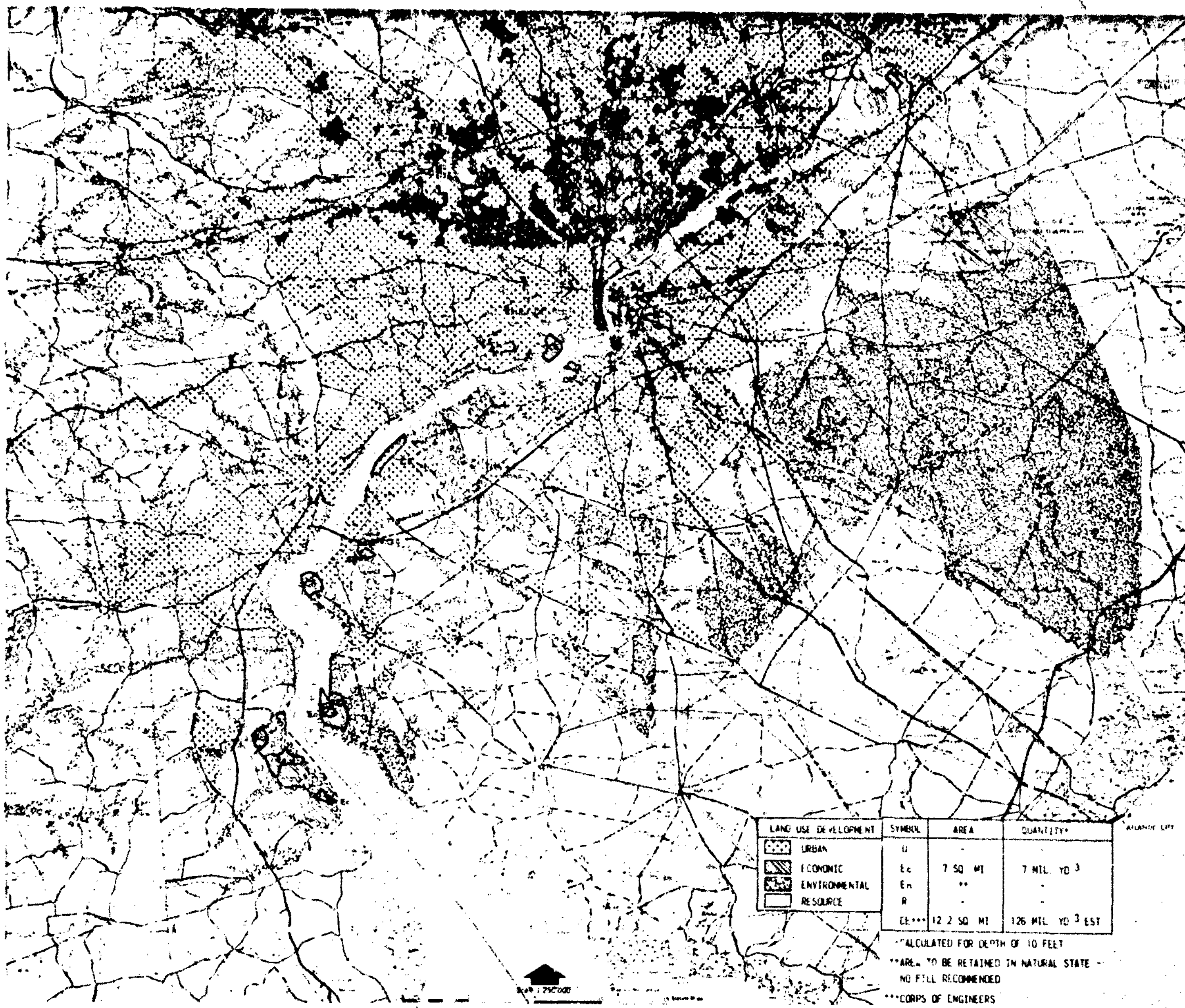

Fig.4.14 Generalized Regional Development Plan Delaware Valley Area

PART 5. GREAT LAKES REGION

General Characteristics

Physiographic Description.

126. The Great Lakes Region consists largely of a forested, poorly drained plain of glacial till attributable to the Wisconsin glacial epoch. The plain is occasionally interrupted by morainal ridges, mostly about 50 feet high, arranged in concentric arcs around the rounded ends of the Lakes. Parts of the till plain are hummocky with nobs and kettle holes containing smaller lakes, ponds and swamps. The region is also characterized by a series of cuestas facing the Superior Upland and sloping away from it. One of these cuestas, the Niagara Escarpment, defines the arcuate north shores of Lakes Michigan and Huron and extends east to Niagara Falls and across New York. The relief of the Great Lakes Region is the result of stream erosion and glacial activity that have cut deeply into the terrain causing a series of low ridges characterized by long, gentle slopes that form the perimeter of the Great Lakes. The climate of the Great Lakes Region is essentially a continental climate moderated by the presence of the large water bodies. Precipitation throughout the area averages about 30 inches per year and average temperatures range from the 20's and 30's in winter to about 75° F. in summer.

127. Figure 5.1 graphically depicts the coastal study zones for the Great Lakes Region. The contour lines indicate successive distance increments of 25 miles from the lake or bay shoreline. Therefore, zone "A" represents the area located between 0 and 25 miles from the coast, zone "B" between 25 and 50 miles, etc. up to 100 miles from the coast which is considered to be the approximate practical limit of inland dredged material utilization. Coastal band "A" contains all of the focal cities of the Great Lakes Region and represents the most highly urbanized area of the region. The area between the metropolitan centers is occupied by croplands, pastures, woodlands and forests. Croplands, pastures, woodlands and forests also occupy most of bands "B", "C", and "D" with the exception of those areas occupied by the large inland cities of Canton, Akron, Rochester and Youngstown. U.S. Army Corps of Engineers Districts include those served by Offices at Buffalo and Detroit.

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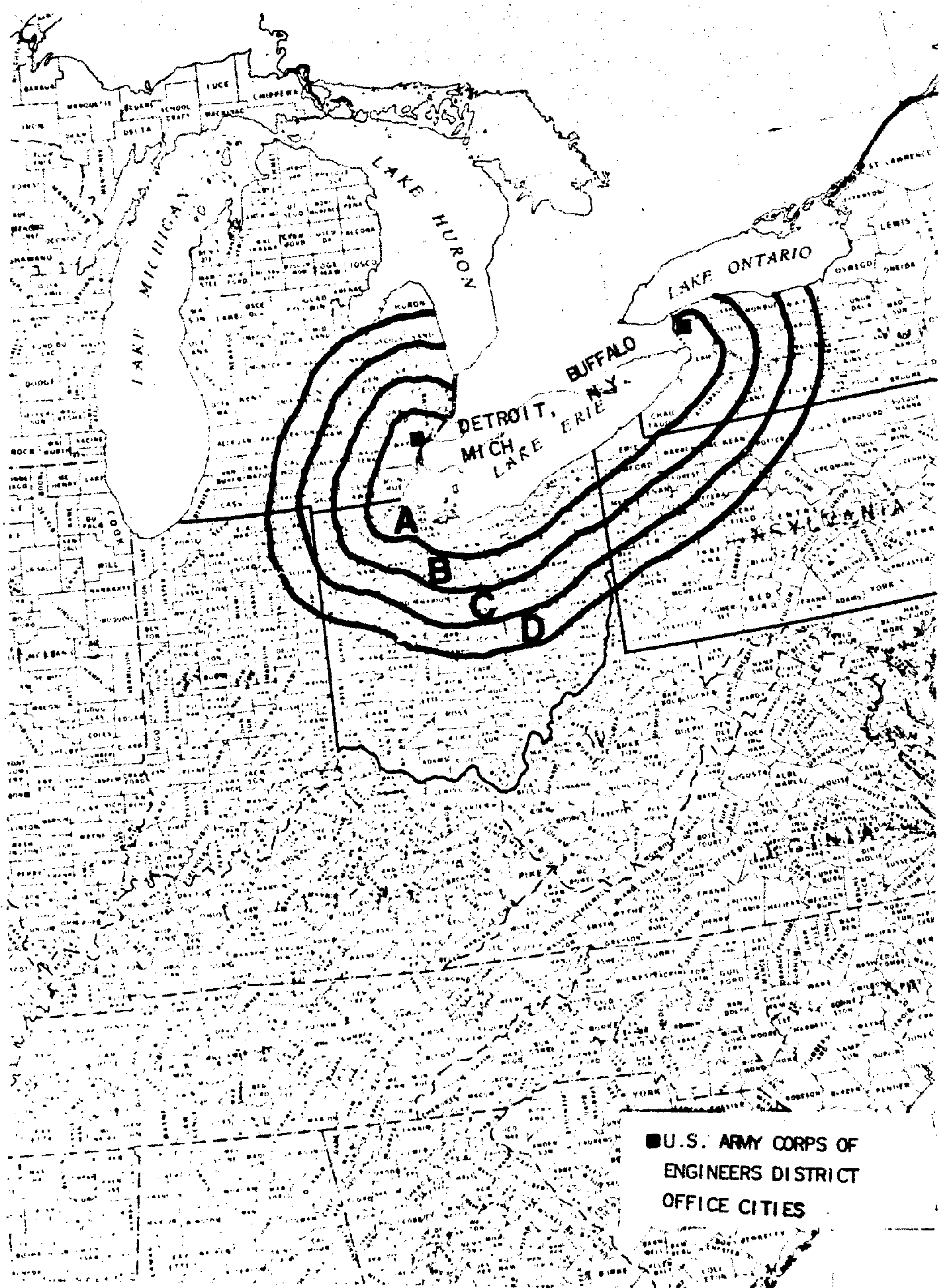

Fig.5.1 Coastal Zones — Great Lakes Region

SCALE 1:7,500,000

Socio-economic profile

128. Figure 5.2 gives population and population density data by state for the coastal study area. Columns "A", "B", "C" and "D" represent the 25 mile increments of distance from the coast described above. The following brief summary of economic parameters included as Table 5.1 includes figures for entire states within the study area except where a proportional division is made for the states of New York and Pennsylvania because of their necessary inclusion in both the Great Lakes and North Atlantic Regions.

129. Minerals. The Great Lakes States are among the largest producers of sand and gravel in the nation. The states of Ohio, Michigan, and New York each produce between 25 and 100 million short tons of sand and gravel annually. Substantial deposits of clay for process industries also exist in the Great Lakes Region. Other important mineral products of the Region include cement, stone, salt, coal, lime, iron ore, and copper.

130. Agriculture. Most of the agricultural lands surrounding the Great Lakes fall into the two broad categories of the Central Fieldgrains and Livestock Region, and the Lake States Fruit, Truck, and Dairy Region. The production of these lands constitutes a major segment of the Great Lakes Economy. Chief farm products of the Region are apples, pears, grapes, sugar beets, cherries, cereals, clover, timothy, maple syrup, milk, vegetables, melons, potatoes, corn, peaches, poultry, eggs, beef, pork, and lamb.

131. Tourism. Many tourists are drawn to the Great Lakes Region each year by the attractive recreational opportunities offered by the region. The figures listed in appendix are for average annual value of tourism to the Region listed by state.

132. Manufacturing. Chief manufactured products of the Great Lakes Region include the following: food and food products, clothing, lumber and wood products, paper and paper products, chemicals, petroleum products, leather goods, stone, clay and glass products, primary metals, fabricated metal products, machinery, electrical equipment, transportation products, and instruments.

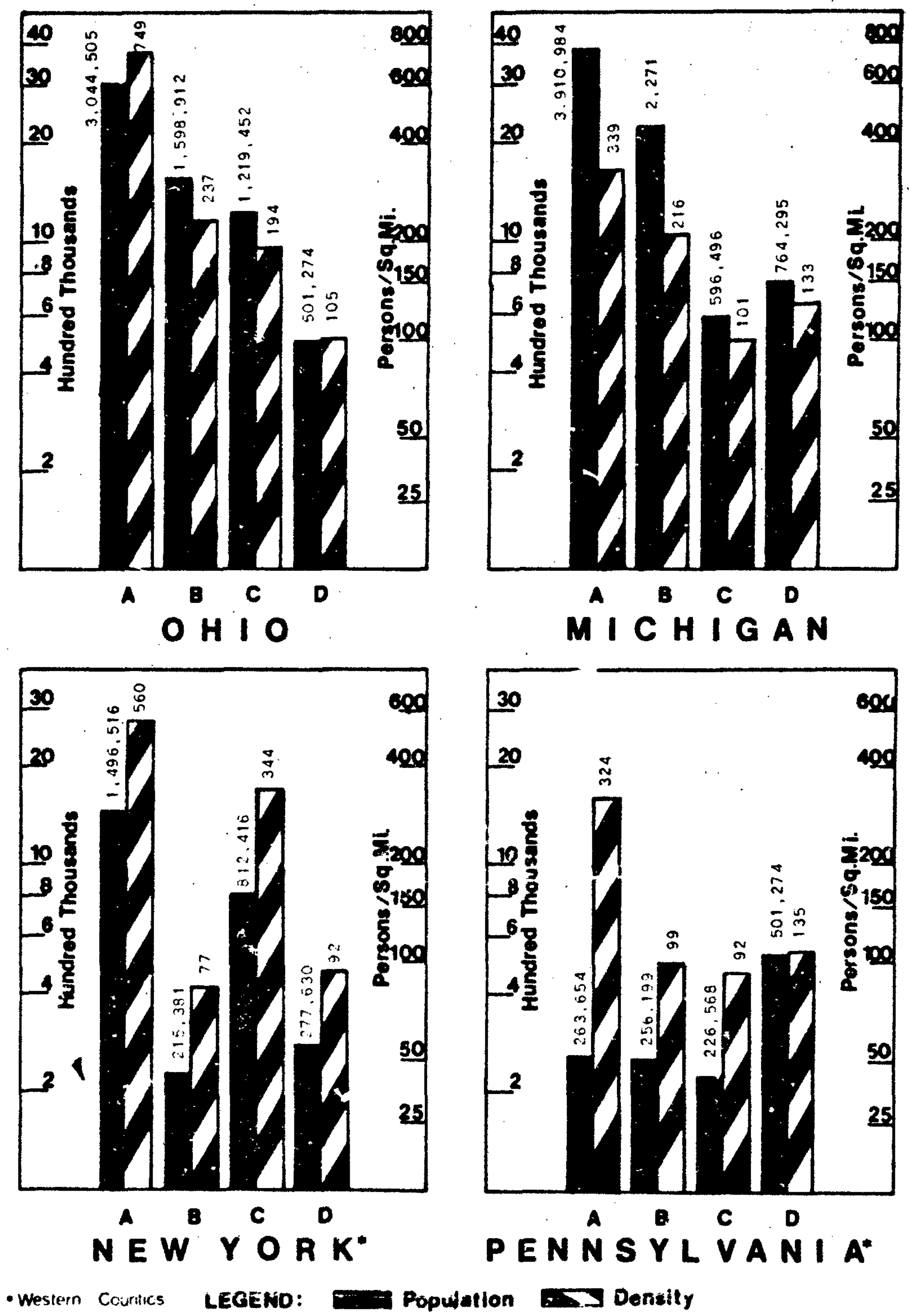

Fig.5.2 Population and Density by Coastal Zone — Great Lakes

Transportation

133. The Great Lakes Region has a well developed highway system including the Interstate 90 and 75 systems connecting the major population centers as well as a radiating pattern of roads connecting the Lake shore areas with inland cities. Rail transportation is a highly developed industry throughout the area. All of the major population centers are located within easy access of international airports. Shipping on the Great Lakes between ports makes up a considerable portion of total shipping volume.

Existing development trends

134. The Great Lakes Region consists of 19 SMSA's within the 100 mile study area surrounding Lakes Erie and Ontario. Analysis of the available data reveals that all portions of the Region experienced growth in the decade from 1960 to 1970. However, the migration trend has been negative in most areas. This fact suggests that migrational shifts are taking place outside the industrialized central counties. Ann Arbor, Michigan, and Rochester, N.Y. experienced substantial growth through in-migration, indicating the trend toward migrational shifts to fill in the spreading urban belt between Buffalo and Chicago. This belt will continue to urbanize and will ultimately form an uninterrupted chain of development across the Great Lakes Region. While the older urban centers will slow down in their growth, new growth centers will increase their pace. The north central portions of Ohio, Pennsylvania, and Western New York will probably show the greatest increases in population growth.

Availability of Dredged Material

Supply

135. A review of focus cities in the Great Lakes Region indicated that the major dredging activity in the area is concentrated on Lake Erie. Corps districts in the Lake Michigan and Lake Superior areas perform the majority of their work on inland waterways and will therefore not be included in this study. The 2 Districts listed below account for 60% of all dredging activity in the Great Lakes Region. Annual dredging quantities are shown in Table 5.2. Table 5.3 gives location of dredged material within the Districts and Table 5.4 shows general characteristics of dredged material.

Demand.

136. Awareness of Availability. Most agencies contacted and visited in the Great Lakes Region were aware of the usage of dredged material as a landfill resource, and had a general understanding of the nature of the material. Few sources contacted had ever thought of dredged material as a possible raw material in the making of construction materials.

137. General Requests for Material. Corps district offices indicated that they have seldom been requested to furnish dredged material as fill for private purposes, and in those few cases that have occurred, applicants have usually become disinterested upon learning the material's physical characteristics and the inherent problems of using dredged material in landfill applications.

Limitations affecting use of dredged material.

138. Economics. In the Great Lakes Region a similar situation exists as in the North Atlantic Region. Substantial regional use has been suggested for dredged material at locations located some distance inland.. Since the nature of the material dredged in this Region eliminates rail or highway transportation, the only practical transportation system is by long distance pipeline. Problems with pipelining in this region include conflicts to be encountered in crossing rail and highway routes and in passing urbanized areas. Transportation problems are compounded in this area by the lack of a major inland waterway system. Dredged material must also compete with better quality materials from active or planned subway excavation projects in several cities.

139. Quality. Quality limitations are fairly universal as applied to use of dredged material for filling areas expected to develop rapidly. Fine-grained materials and materials possessing a high degree of pollution are difficult to dispose of, as is the case in other regions. About 78% of the material dredged in this area is either fine-grained or a mixture of fines and fine sands. These materials can be viable as fill when present readily available sources deplete, provided they are incorporated into the planning process to allow sufficient time for in-place characteristics to improve. Throughout the Great Lakes Region there is an abundance of sand and gravel for process industries and clay for brickmaking. No research

or experimentation on construction usage of dredged material was uncovered in the Region. It is doubtful that dredged material will be considered as a construction material until the abundance of other materials ceases or a distinct economic advantage develops for using dredged material.

140. Environmental constraints. The best and most economical scheme for dredged material in the Great Lakes Region lies in filling marshlands and shallow water diked areas. Strong opposition to this type of disposal exists throughout the Region from conservationists and sportsmen's groups. These groups would like to ban all marshland disposal because of feared ecological changes resulting from dredging and disposal operations, even though a definitive analysis of the effects of disposal on wetlands is not available. Strong fears also exist in connection with possible dike failures and subsequent release of pollutants to adjacent waters. All of these objections have resulted from an increased awareness of the value of these wetlands as spawning and nursery areas. Consequently, most states have charged their natural resource agencies with overseeing these areas and have passed laws designed to protect wetland areas from encroachment. Usually it is not possible to obtain approval for disposal of maintenance dredging material in marshlands unless it can be clearly demonstrated that no other feasible alternative exists.

141. Other limitations. Additional restrictions on landfill disposal of dredged material are imposed by difficulties in obtaining and holding leases and easements on disposal lands. Frequently, owners of shoreline property will grant easements to the Corps for deposition of material to a specified elevation and then reclaim the land long before this elevation is reached to construct a building on the site as the site is filled above tidal level. Added to this problem is the general difficulty of acquiring leases or easements on disposal lands brought about by a general increase in value of coastal lands.

Regional Landfills

Sampling of landfill projects

142. Matrix 5A presents a regional inventory of reported landfill projects both existing and proposed. These projects are those described in reports, literature and personal interviews as well as in letters and telephone conversations with government agencies,

planning groups, port authorities, Corps District Offices, chambers of commerce and other interested individuals and groups throughout the region. Matrix 5A presents these reported projects in a form showing location of dredged material usage with respect to the 25 mile incremental distance bands indicated by the lettered columns. The numerals 1, 2 and 3 indicate suggested, proposed and existing usages respectively. Tables 5.5, 5.6, 5.7 and 5.8 present brief descriptions for a sampling of projects for each focal city within the Region. For additional information, each of these descriptions is referenced with a key number indicating the source of the reported activity. The data contained in Matrix 5A is summarized in Figure 5.3. Supplemental data, including more detailed project descriptions and copies of actual letters received, may be found in the Appendix.

143. Varied use has been made of dredged fills in the past throughout the Great Lakes Region. The Toledo-Lucas County Port Authority has placed 480,000 cubic yards of dredged material in a landfill for development of new port facilities. In Michigan, 2 million yards were placed on the west side of Saginaw River in Saginaw for industrial expansion. In Buffalo, the Niagara Frontier Transportation Authority has added 250 acres of light industrial land to the Harbor shoreline with dredged material deposited in a diked containment area. In Wayne and Monroe Counties, Michigan, dredged material has been used to check serious erosion problems in valuable wildlife areas.

Example projects.

144. Many proposals for dredged fill development and utilization exist throughout the Region as shown in Matrix 5A. The following descriptions outline the relevant facts on a few of these proposals. Approval is presently being sought for a permit to construct a 400 acre diked disposal island in Toledo Harbor. This structure will replace the current dredged material disposal site known as Toledo Island. This proposed diked island will enclose four existing small islands created by previous Corps of Engineers dredging projects. The dike for the proposed project is to be consistent with the Toledo-Lucas County Port Authority's port expansion program. This program envisions using the diked

MATRIX 5A

		SAMPLING OF LANDFILL PROJECTS	USACE DISTRICTS - COASTAL ZONES															
			BUFFALO				CLEVELAND				TOLEDO				DETROIT			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL: HOUSING	2	2	-	-	1	1	2	-	-	2	2	-	-	-	-	-
		COMMERCIAL	2	2	2	-	1	1	2	-	-	2	2	-	-	-	-	-
		RESORTS: COMMERCIAL CAMPS	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		COMMUNITY FACILITIES	2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
		MEAN	2.0	1.5	0.5	0	0.5	0.5	1.0	0	0.5	1.0	1.0	0	0	0	0	0
	ECONOMIC	INDUSTRIAL	3	2	-	-	-	1	1	-	-	-	2	-	1	1	3	1
		RAIL: RAPID TRANSIT	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		AIRPORTS	1	1	-	-	3	2	-	-	-	-	-	-	-	-	-	-
		HARBORS: PORTS	3	3	3	2	-	2	-	-	3	2	-	-	2	2	-	-
		HIGHWAYS	2	2	-	-	-	-	-	-	-	1	1	-	-	-	-	-
		UTILITIES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MEAN	1.8	1.6	0.5	0.3	0.5	0.8	0.2	0	0.5	0.5	0.5	0	0.5	0.5	0.5	0.2
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	2	-	-	-	-	-	-	-	2	2	-	-	1	3	3	1
		MARINE NURSERIES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BEACH NOURISHMENT	-	2	3	3	-	2	2	-	2	2	-	-	-	2	2	3
		PARKS & RECREATION: PUBLIC	2	1	3	-	2	1	2	-	-	2	2	-	2	2	2	-
		MARSHLAND MANAGEMENT	-	-	-	-	-	-	-	-	2	2	-	-	1	2	2	2
		SANITARY LANDFILLS	2	-	-	-	1	1	1	-	-	-	2	-	-	-	-	-
		OTHER LANDFILLS	1	2	3	-	-	2	-	2	1	1	1	-	-	-	-	-
		FLOOD PLAIN CONTROLS/LEVEES	3	2	3	1	-	-	-	-	-	2	1	-	-	-	-	-
		MEAN	1.3	0.9	1.5	0.5	0.4	0.8	0.6	0.2	0.9	1.3	0.8	0	0.5	1.1	1.1	0.8
	RESOURCE	ARTIFICIAL ISLANDS	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-
		AGRICULTURAL/GRAZING LAND	2	2	1	1	-	-	-	-	-	1	1	-	-	-	-	-
		FORESTRY	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BRICK MFG.: CERAMICS, ETC.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		LAND RECLAMATION	3	2	3	1	-	2	2	2	-	1	1	-	2	2	3	3
		SAND & GRAVEL	2	2	-	-	-	-	-	-	-	-	-	-	1	1	1	-
		MATERIAL STOCKPILES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MEAN	1.2	1.0	0.8	0.3	0	0.3	0.3	0.3	0.3	0.3	0.3	0	0.4	0.4	0.5	0.4
		MEAN VALUES	1.6	1.3	0.8	0.3	0.4	0.6	0.5	0.1	0.5	0.8	0.7	0	0.4	0.5	0.5	0.3

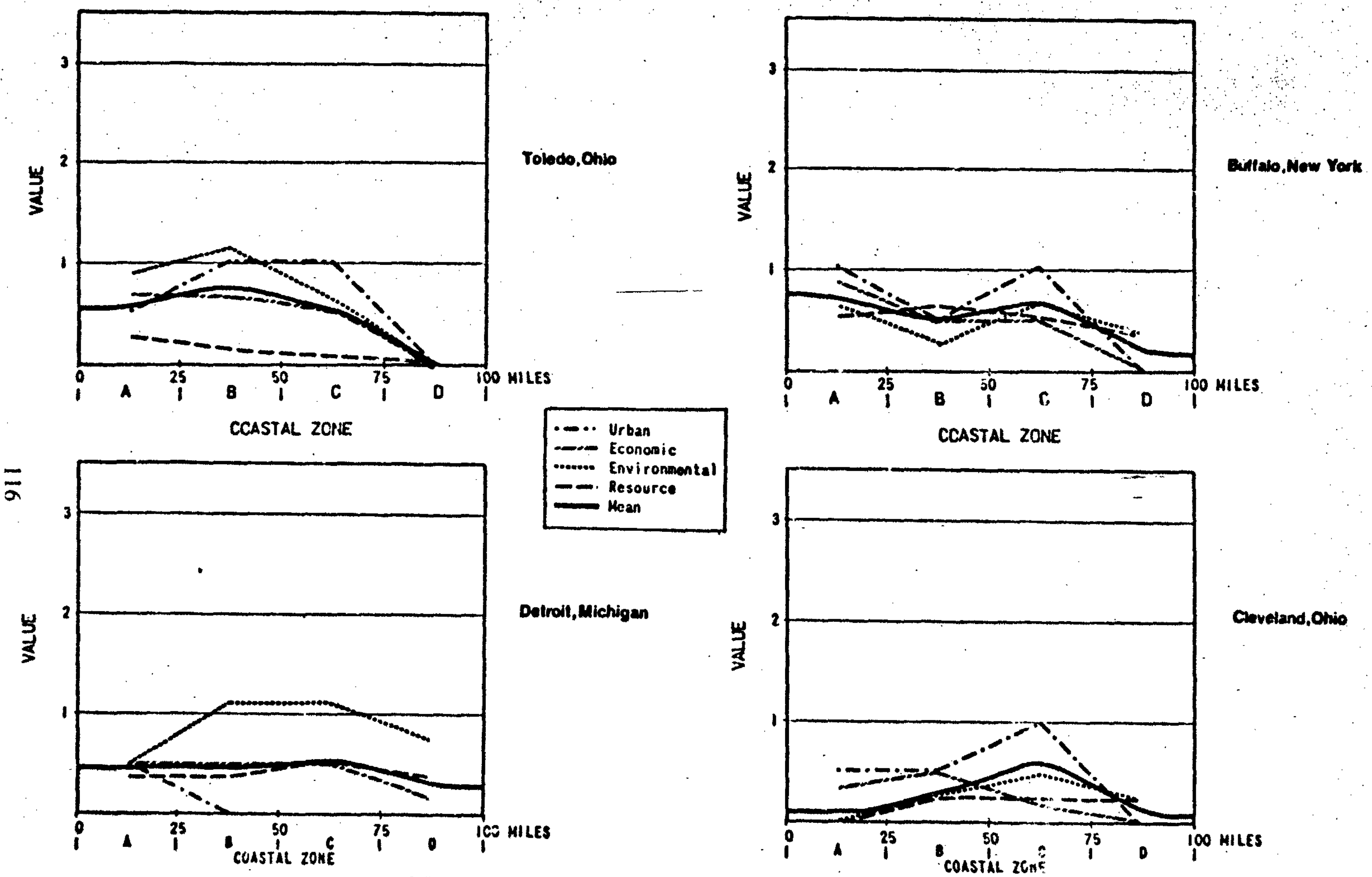

Fig. 5.3 Existing Landfill Projects
MATRIX 5A

island as docking space and related industrial sites. This proposed facility will increase the commercial shipping use of Maumee River and Bay and benefit the water quality of Lake Frie by storing pollutants that would otherwise eventually enter the Lake.[5.3.]

145. In the Buffalo District there is a proposal now in the planning process to create a dredged fill park in Huron Harbor. This park will be constructed at the end of an existing breakwater structure as a semicircular development 2,200 feet in radius. This plan was developed by public officials of the City of Huron with the help of Stanley Consultants of Muscatin, Iowa. Similar plans for dredged fill recreational areas exist for Conneaut and Fairport Harbors in Ohio. A similar proposal in the Detroit District to deposit dredgings on Harbor Island at Grand Haven, Michigan has been taken up by local community leaders.

Potential Landfill Projects.

146. Matrix 5B presents an inventory of potential landfill usage shown by distance from the focal city under consideration. These potentials are based largely on the premise that future dredged material fills can most likely be developed in areas and in situations where they have been utilized in the past. Also included in lists of potential usages are suggestions made by the sources contacted during the study which have not yet come to the status of a proposed use. Once again, the lettered columns indicated distance from the principal source of dredging at the focal city. The numbers 1, 2 and 3 in Matrix 5B indicate least, moderate and greatest potential. Matrix 5C shows a quantitative assessment based on the potential usages of Matrix 5B. In Matrix 5C the numbers 1, 2 and 3 serve to indicate relative estimated quantities of material usable in the particular application. All of the information presented in Matrices 5B, and 5C is summarized in graphic form in Figures 5.4 and 5.5.

147. A review of the letters submitted by sources contacted during this study will indicate that many contacts recommended the use of dredged material to reclaim strip mines, quarries and as cover material and possible developmental fill for sanitary landfills. This category of usage represents the most frequently suggested idea reported from the

MATRIX 5B

LAND USE DEVELOPMENTS	POTENTIAL LANDFILL PROJECTS	USACE DISTRICTS - COASTAL ZONES															
		BUFFALO				CLEVELAND				TOLEDO				DETROIT			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
URBAN	RESIDENTIAL; HOUSING	2	2	1	1	1	1	2	-	2	2	2	1	1	1	1	1
URBAN	COMMERCIAL	2	2	2	1	1	2	2	-	1	2	2	1	1	1	1	1
URBAN	RESORTS; COMMERCIAL CAMPS	2	1	2	1	-	-	-	-	-	-	-	-	-	-	1	1
URBAN	COMMUNITY FACILITIES	2	2	1	1	-	-	-	-	2	-	-	-	2	-	-	-
URBAN	MEAN	2.0	1.8	1.5	1.0	0.5	0.8	1.0	0	1.3	1.0	1.0	0.5	1.0	0.5	0.8	0.8
ECONOMIC	INDUSTRIAL	3	2	-	-	1	1	1	1	1	1	2	-	1	1	3	1
ECONOMIC	RAIL; RAPID TRANSIT	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
ECONOMIC	AIRPORTS	2	2	-	-	3	2	1	1	-	-	-	-	-	-	-	-
ECONOMIC	HARBORS · PORTS	3	3	3	2	-	1	2	-	3	2	1	-	2	2	1	1
ECONOMIC	HIGHWAYS	2	2	1	1	-	-	-	-	1	1	1	1	-	-	-	-
ECONOMIC	UTILITIES	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ECONOMIC	MEAN	2.2	2.0	0.8	0.5	0.7	0.7	0.7	0.3	0.8	0.7	0.8	0.2	0.5	0.5	0.7	0.3
ENVIRONMENTAL	WILDLIFE REFUGES; ROOKERIES	2	-	-	-	-	-	-	-	2	2	2	-	1	3	3	1
ENVIRONMENTAL	MARINE NURSERIES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ENVIRONMENTAL	BEACH NOURISHMENT	1	2	3	3	-	2	2	-	2	2	1	-	1	2	2	3
ENVIRONMENTAL	PARKS & RECREATION: PUBLIC	2	2	3	-	1	1	2	2	1	2	2	-	2	2	2	1
ENVIRONMENTAL	MARSHLAND MANAGEMENT	2	1	-	-	-	-	-	-	2	2	-	-	1	2	2	2
ENVIRONMENTAL	SANITARY LANDFILLS	2	1	-	-	-	-	-	-	2	1	2	-	1	1	-	-
ENVIRONMENTAL	OTHER LANDFILLS	1	2	3	-	1	2	2	2	1	1	1	-	1	1	1	1
ENVIRONMENTAL	FLOOD PLAIN CONTROLS/LEVEES	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
ENVIRONMENTAL	MEAN	1.6	1.2	1.0	0.4	0.3	0.6	0.6	0.5	1.3	1.3	1.0	0	0.9	1.[illegible]	1.3	1.0
RESOURCE	ARTIFICIAL ISLANDS	1	1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
RESOURCE	AGRICULTURAL/GRAZING LAND	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
RESOURCE	FORESTRY	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RESOURCE	BRICK MFG.; CERAMICS, ETC.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RESOURCE	LAND RECLAMATION	3	3	3	2	1	2	2	2	2	1	-	-	2	2	3	3
RESOURCE	SAND & GRAVEL	2	2	-	-	-	-	-	-	-	-	-	-	1	1	1	-
RESOURCE	MATERIAL STOCKPILES	1	1	1	-	1	1	1	-	1	1	1	-	1	1	1	-
RESOURCE	MEAN	1.4	1.4	0.9	0.6	0.3	0.4	0.4	0.3	0.4	0.3	0.1	0	0.4	0.5	0.6	0.4
	MEAN VALUES	1.8	1.6	1.1	0.7	0.5	0.6	0.7	0.3	0.9	0.8	0.9	0.2	[illegible]	0.7	0.8	0.6

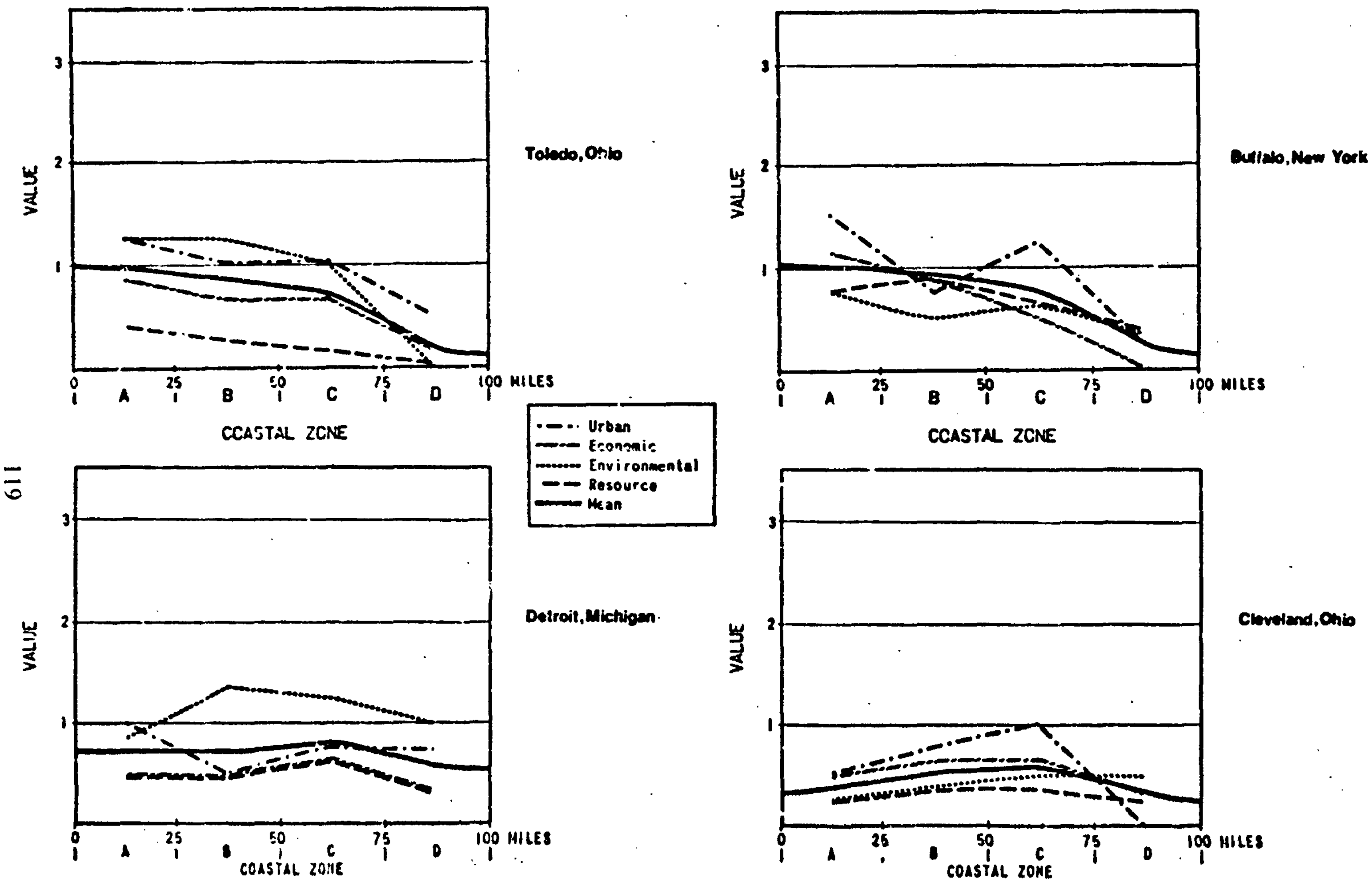

Fig. 5.4 Potential Landfill Projects
MATRIX 58

MATRIX 5C

		QUANTITATIVE ASSESSMENT	USACE DISTRICTS - COASTAL ZONES															
			BUFFALO				CLEVELAND				TOLEDO				DETROIT			
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	2	2	1	1	1	2	2	-	2	2	2	2	2	2	2	2
		COMMERCIAL	2	2	1	1	1	2	2	-	2	2	2	2	2	2	2	2
		RESORTS; COMMERCIAL CAMPS	2	2	1	1	-	-	-	-	-	-	-	-	-	-	1	1
		COMMUNITY FACILITIES	2	1	1	1	-	-	-	-	1	-	-	-	1	-	-	-
		MEAN	2.0	1.8	1.0	1.0	0.5	1.0	1.0	0.0	1.3	1.0	1.0	1.0	1.3	1.0	1.3	1.3
	ECONOMIC	INDUSTRIAL	3	2	-	-	2	2	3	1	3	3	3	-	2	2	2	2
		RAIL: RAPID TRANSIT	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		AIRPORTS	2	2	-	-	3	2	2	2	-	-	-	-	-	-	-	[illegible]
		HARBORS: PORTS	3	1	1	3	-	1	1	-	2	3	2	-	3	[illegible]	2	[illegible]
		HIGHWAYS	2	2	2	2	-	-	-	-	2	2	2	2	-	-	-	-
		UTILITIES	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MEAN	2.2	1.8	0.8	0.8	0.8	0.8	1.0	0.5	1.2	1.3	1.2	0.3	0.8	0.8	0.7	0.7
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	1	-	-		-	-	-	-	3	3	3	-	2	2	1	1
		MARINE NURSERIES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BEACH NOURISHMENT	1	1	1	1	-	-	-	-	1	1	1	-	1	1	1	1
		PARKS & RECREATION: PUBLIC	2	2	2	-	2	2	2	2	2	2	2	-	2	2	2	2
		MARSHLAND MANAGEMENT	2	2	-	-	-	-	-	-	3	3	-	-	2	3	2	2
		SANITARY LANDFILLS	1	1	-	-	1	1	1	-	1	1	1	-	1	1	-	-
		OTHER LANDFILLS	2	2	-	-	2	2	2	2	2	2	2	-	2	2	2	2
		FLOOD PLAIN CONTROLS/LEVEES	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		MEAN	1.4	1.3	0.6	0.1	0.6	0.6	0.6	0.5	1.5	1.5	1.1	0	1.3	1.4	1.0	1.0
	RESOURCE	ARTIFICIAL ISLANDS	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		AGRICULTURAL/GRAZING LAND	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
		FORESTRY	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		BRICK MFG.: CERAMICS, ETC.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		LAND RECLAMATION	2	1	1	2	2	2	2	2	2	2	-	-	3	3	3	3
		SAND & GRAVEL	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2	-
		MATERIAL STOCKPILES	3	3	3	-	3	3	3	-	3	3	3	-	3	3	3	-
		MEAN	1.5	1.3	1.0	0.8	0.6	0.6	0.6	0.3	0.6	[illegible]	0.4	0	1.0	[illegible]	[illegible]	0.4
		MEAN VALUES	[illegible]	1.6	0.9	0.7	0.6	0.8	0.8	0.3	1.1	1.1	0.9	0.3	1.1	1.1	1.0	0.8

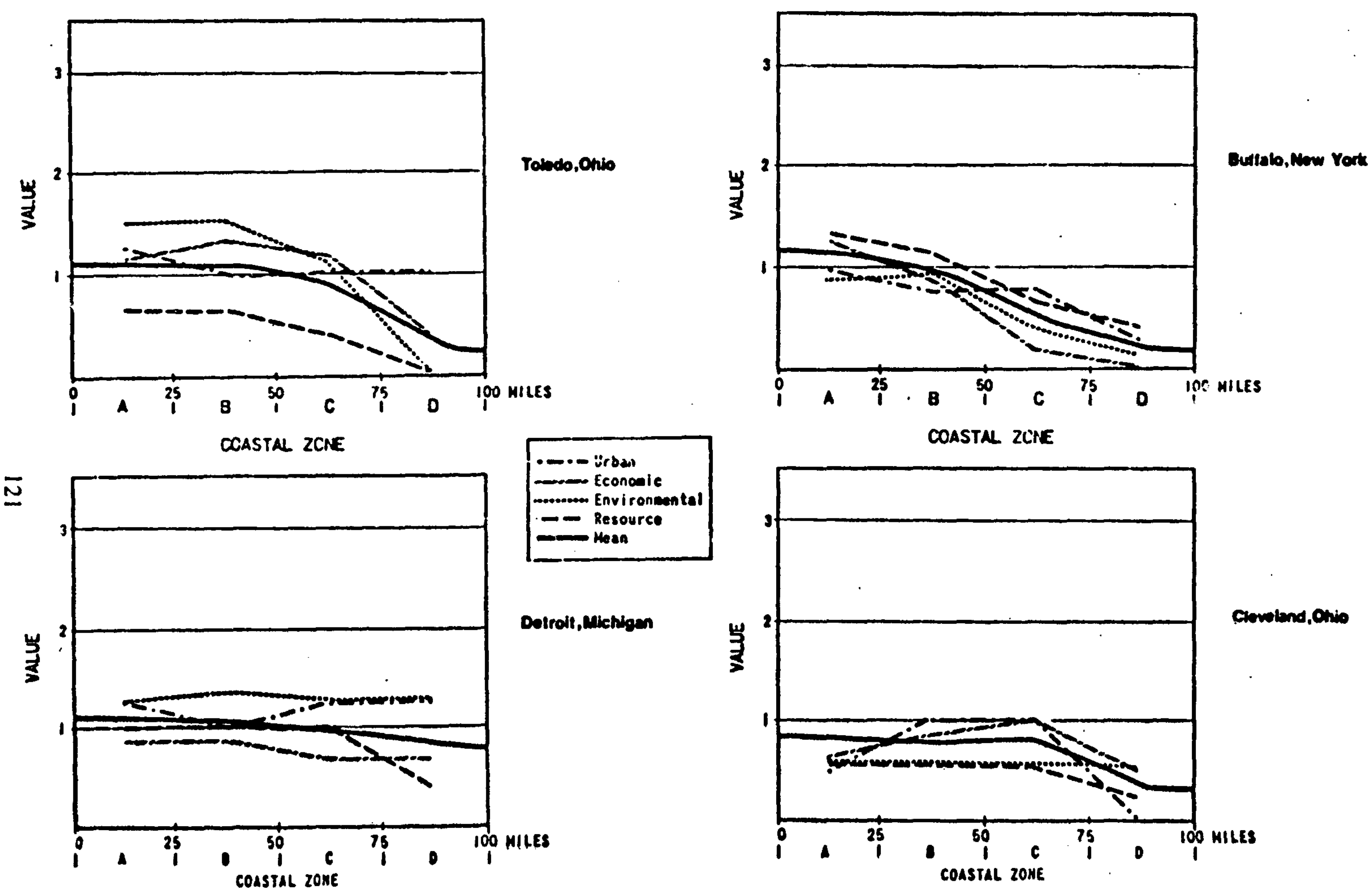

Fig. 6.5 Quantitative Assessment
MATRIX 5C

Region. Typical of these potential uses is a proposal to extend the area of Grodon Park, a shoreline recreational area in Cleveland, by filling with municipal refuse and dredged material cover layers.

148. In Monroe, Michigan an experiment is under way to test the feasibility of using dredgings from ship channels to fill lowlands ashore. Mr. Max McCray, Monroe's Port Director, has great faith in the future development of Monroe as a major regional port. A feasibility study is planned to investigate this possibility. If the test of the dredged fill has beneficial results, the door would be open for developing 500 acres of shoreland as port and industrial sites and an island in Lake Erie off Monroe Harbor where giant vessels could dock and discharge their cargoes. Mr. McCray also feels that such dredged fill sites would provide more suitable sites for heavy industry, power plants, and waste treatment facilities.

149. The "National Shoreline Study - Great Lakes Region Inventory Report" identifies over 150 miles of what is described as "critically eroded" shoreline in the States included in the study area for the Great Lakes Region. Beach nourishment and erosion protection have been practiced in the past, but these measures can be intensified in the future, particularly with the cleaner materials encountered in new work dredging, to prevent the eventual loss of valuable shoreline resources.[5.6.]

Sample of future land use and development plans.

150. Figure 5.6 is an adaptation of the Erie and Niagara County Regional Planning Board's Future Land Use Map for Buffalo, Niagara Falls, and sourrounding areas. This figure locates identified areas of potential dredged material utilization. Each area is shown with a symbol indicating the intended use of the land after filling. The indicated environmental use area north of Lackawanna represents a proposal by the City of Buffalo to fill 40 to 50 acres of the area known as Lehigh Valley Basin to create a wildlife area. The environmental use area shown at the shoreline at Lackawanna represents a proposal to fill the area between the end of the existing breakwater and the adjacent shore of the Bethlehem Steel Company's Lackawanna Plant. This fill will provide land for a park development in partial satisfaction of an often expressed need for shoreline park areas

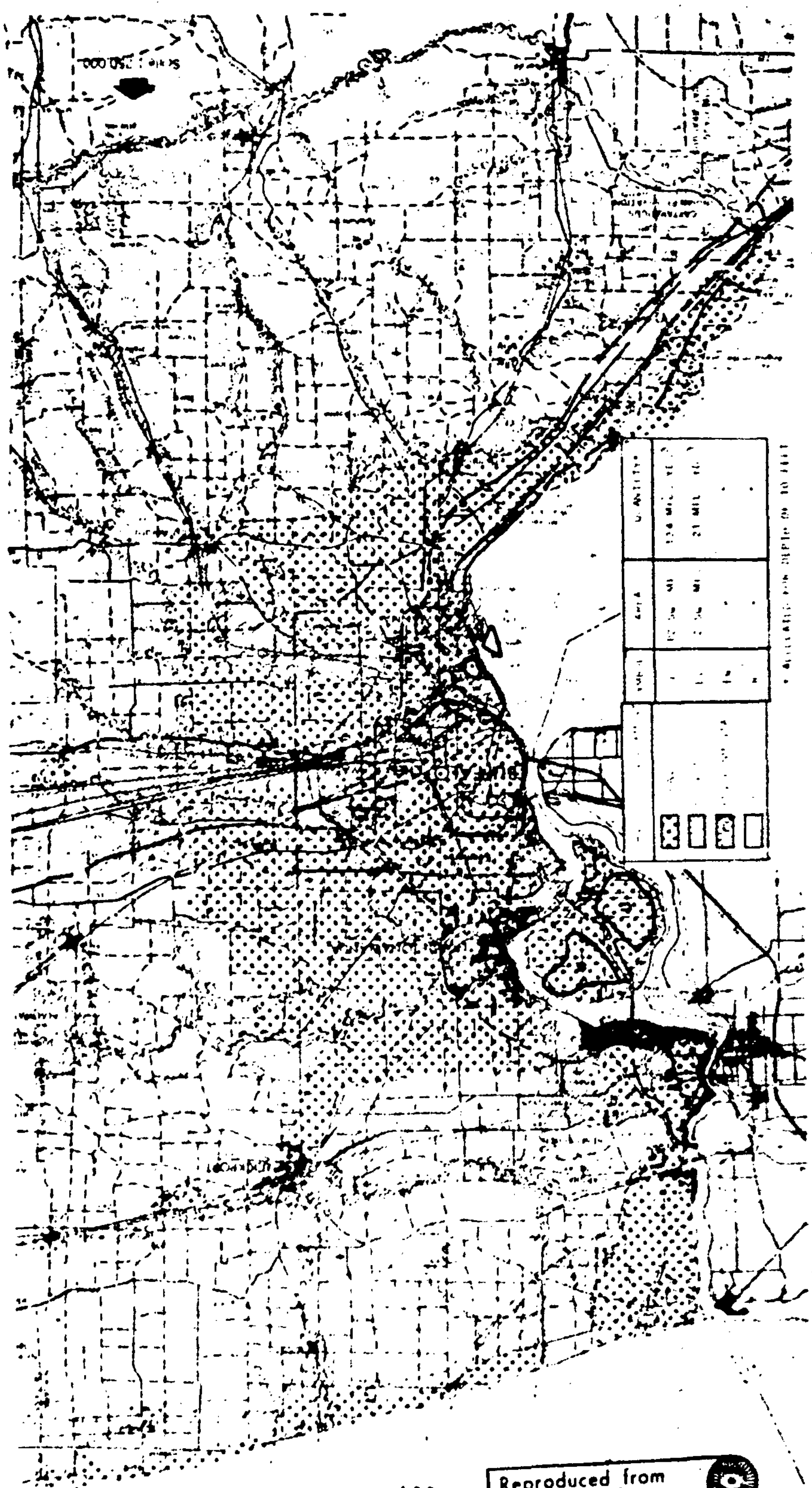

Fig.58 Generalized Regional Development Plan
Buffalo Area

around Buffalo. The areas of potential development of urban complexes shown are anticipated commercial and residential developments on Grand Island, a low lying tract of largely undeveloped land. In addition to the areas of potential development with dredged material, the area of Amherst, an eastern suburb of Buffalo, has been identified by the Planning Commission as an expected area of development that could possibly use dredged fill material. The Amherst area will be the site of a new University of Buffalo campus. The location of the University at Amherst will also promote residential and commercial development of the area.[5.11]

PART 6. PACIFIC COAST REGION

General Characteristics

Physiography.

151. Generally the Pacific Coast Region is a mountainous and rugged terrain. At its northern end is the Puget Trough, a partly submerged lowland generally less than 500 feet in altitude. The Puget Trough, which includes the Willamette Valley, extends approximately 1500 miles from its southern end through Oregon, Washington, and up through British Columbia into Alaska. The southern end is a valley 200 miles long and about 25 miles wide. Through Washington and part of Oregon the valley is bounded on the east by the Cascade Mountains. These mountains are primarily granitic and volcanic mountains forming a natural boundary which can be crossed at only a few places. The mountains are an uplift further heightened in places by volcanoes and lava. The highest portions being in the northern end of the Cascades. On the western side and parallel with the coastline, the trough is bounded by the Olympic Mountains which are complexly folded and faulted formations reaching an altitude of 8000 feet. Further south the Puget Trough is bounded on the east by the Cascades, and on the west by the Oregon Coastal Range. The Oregon Coastal Range consists of irregular hills and low mountains, the highest being generally less than 3000 feet. Below the Oregon Coastal Range, the Puget Trough disappears into the Klamath Mountains. There are only three rivers which cross the Cascades: the Columbia, Klamath, and Pit.

152. Southward, below the Klamath Mountains, begins the California Trough. This forms the Great Valley between the Sierra Nevadas on the east and the California Coast Ranges on the west. Most of this trough is below 500 feet in atlitude with more than one third being less than 100 feet in altitude. The northern portion is drained by the Sacramento River and the southern portion by the San Joaquin River. The approximate midpoint of the trough is at the intersection of these two rivers where they empty into San Francisco Bay. On the western side of the trough is the California Coastal Range which parallels the coast and is generally less than 5000 feet in altitude. On the east of the California Trough are the

Sierra Nevadas, a formidable barrier which can only be crossed in a few places. The Sierra Nevada is a huge block mountain 350 miles long and 60 miles wide. They are the only mountains in the United States which are not crossed by a river. Below the California Trough are the Transverse Mountains generally reaching altitudes of 10,000 feet and extending along the San Andreas Fault. These blend into the Los Angeles Basin, a coastal lowland covering about 1000 square miles. This is the only portion of the coast which could be considered a coastal plain. The rest of the mountainous coast is part of the circum-Pacific volcanic belt and has had fairly recent volcanic activity. It is also part of a seismically active belt along the Pacific and is subject to recurring and frequently severe earthquakes.

Coastal zones.

153. Figure 6.1 graphically displays the "coastal zones" for the Pacific Coast Region. The contour type lines delineate a distance of 25 miles each, measured from coastal shores except in the case of Portland, Oregon, where the increments are 25 miles apart with the Portland area as the source of material. Each 25 mile "zone" is identified by alphabet letters "A" through "D" which represents the 100 mile limit established for the study. All three focal cities (Seattle, Portland, and San Francisco) are located in Zone A. Generally, each zone, "A" through "D", contains mountainous rugged terrain, with a mountainous coastline. The southern end of Puget Trough in the north and the California Trough farther south are the exceptions. The Puget Trough is a lowland valley in zones "B" and "C" paralleling the coast in Oregon and Washington. Likewise, the California Trough is located within zones "B", "C" and portions of "A" generally parallel to the coast. U.S. Army Corps of Engineer Districts include those served by district offices located at Seattle, Washington; Portland, Oregon; and San Francisco, California.

Socio-economic profile.

154. A review of social and economic activity provides a basis to scale probable demands for construction and landfill materials. Needs are generated by people in the locations in which they are found and the level of this need is predicted somewhat on the

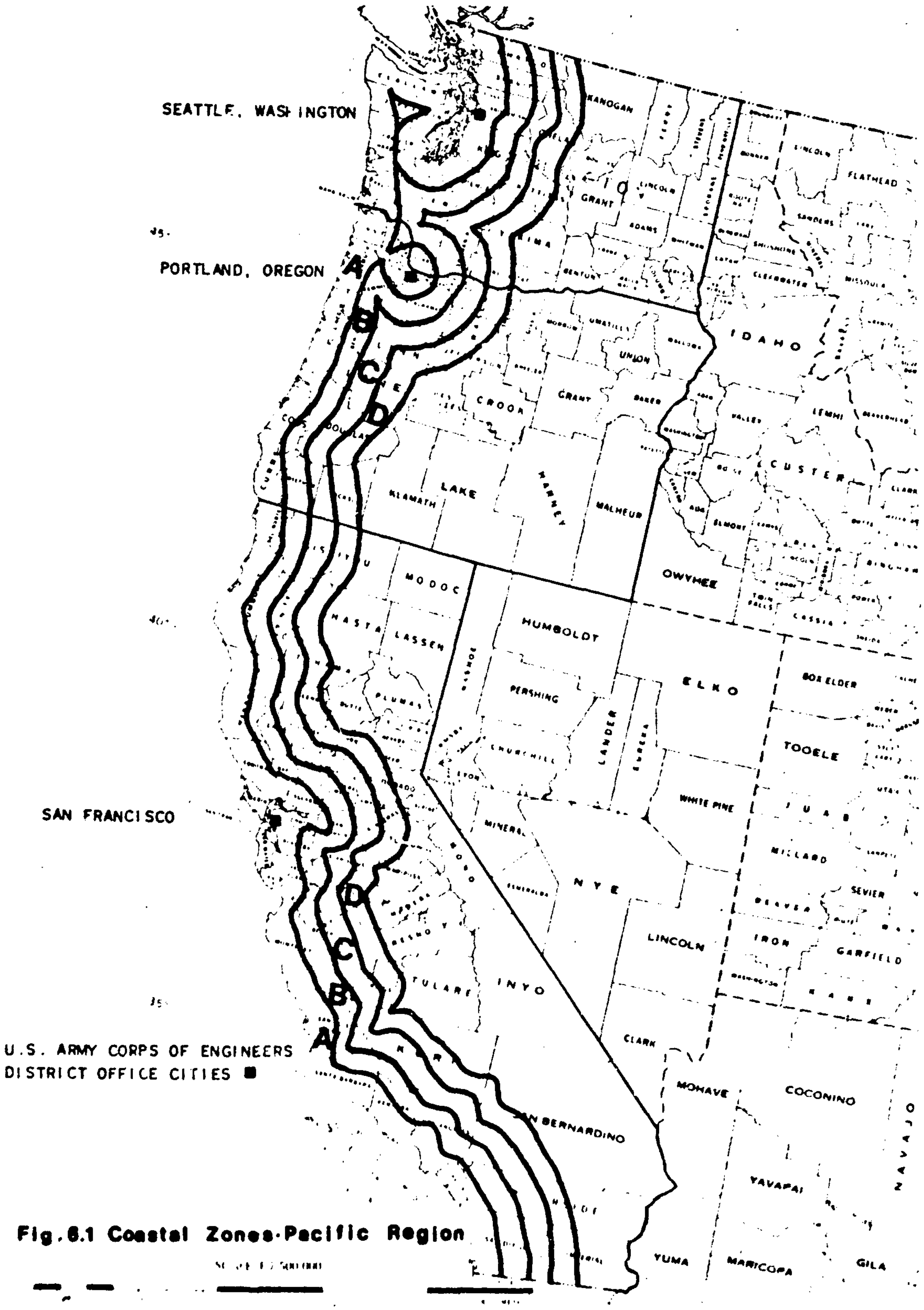

Fig. 6.1 Coastal Zones-Pacific Region

intensity of development and future growth trends. Levels of development can be determined from selected population and economic indicators such as population distribution and density, family income, manufacturing, retail sales and agricultural productivity. These indicators, when compared to past years, can also be used to estimate future trends. Selected data of general Economic Profile is depicted in Table 6.1.

155. Manufacturing. Chief manufactured projects of the Pacific Coast Region include transportation equipment, wood products, foodstuffs, paper products, metals and metal products, chemicals, nuclear fuels, and machinery.

156. Minerals. A highly diversified mineral industry is carried on in the Pacific Coast Region whose main products are sand and gravel, stone, silver, lime, zinc, lead, pumice, oil, cement, nickle, asbestos, baron, tungsten and gypsum.

157. Agriculture. Chief agricultural products of the Pacific Coast Region are apples, pears, peaches, plums, prunes, citrus, olives, dates, cherries, apricots, persimmons, pomegranate, filberts, nuts, berries, grapes, potatoes, grain and cotton.

158. Tourism. Many tourists are drawn annually to the attractive scenery and recreational opportunities offered by the Pacific Coast Area making tourism a major economic impact on the area.

Population distribution and density.

159. Population number and density for the study regions are shown in Figures 6.2 and 6.3. Columns "A", "B", "C", and "D" represent 25 mile increments from the coast. The population statistics and areas given are proportioned from county population and areas which are contained in each 25 mile band width.

Transportation

160. The three Pacific Region focal cities of Seattle, Portland and San Francisco are connected by Interstate 5. This is the principal north-south highway through the region. Interstate 5 follows the Puget Sound coastline in Washington and connects many of the coastal cities. Below Puget Sound south through Oregon and California Interstate 5 is approximately 60 to 80 miles inland. Connecting Interstate 5 to the coast in this area are

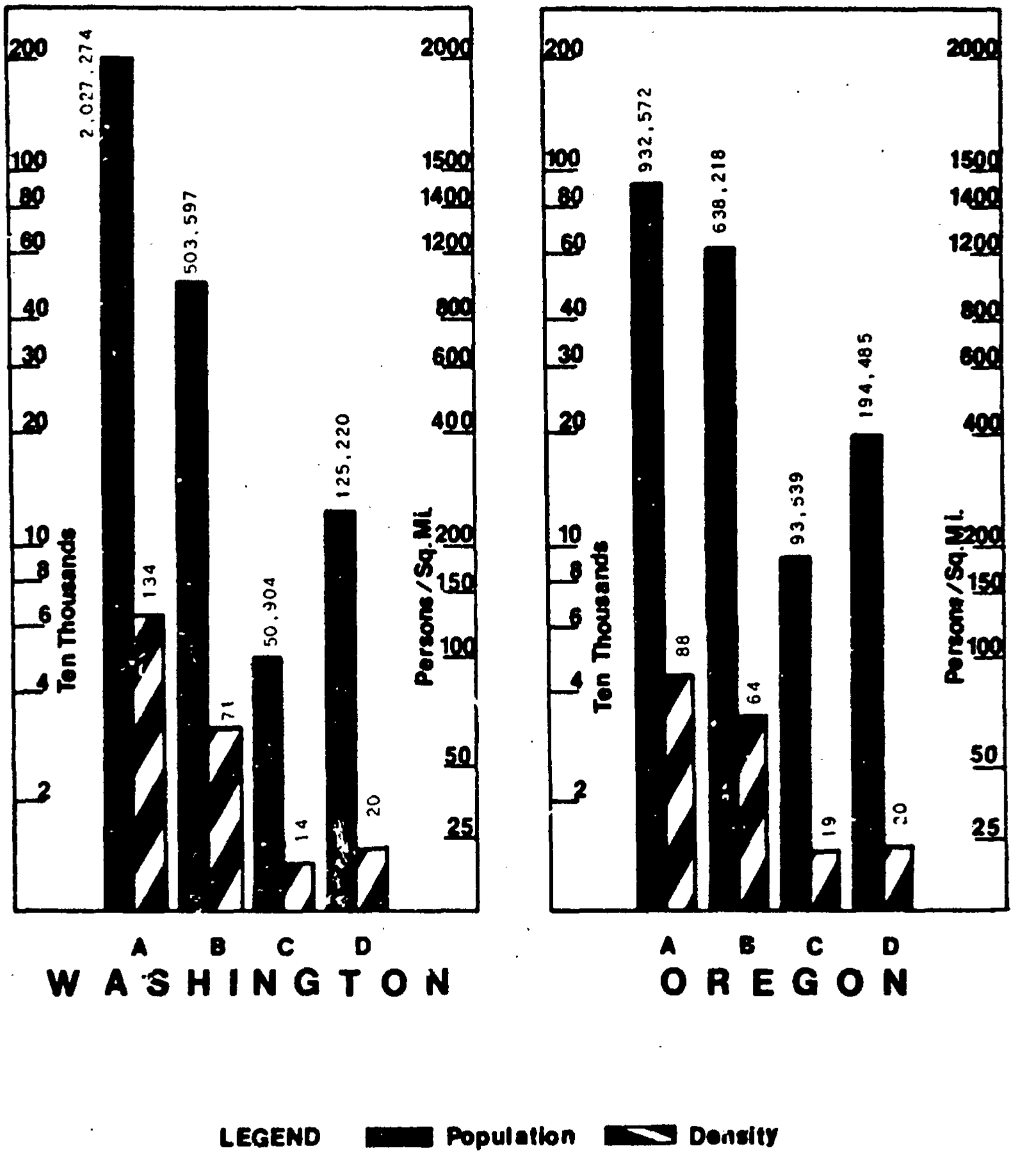

Fig 6.2 Population and Density by Coastal Zone — Pacific Coast
WASHINGTON AND OREGON

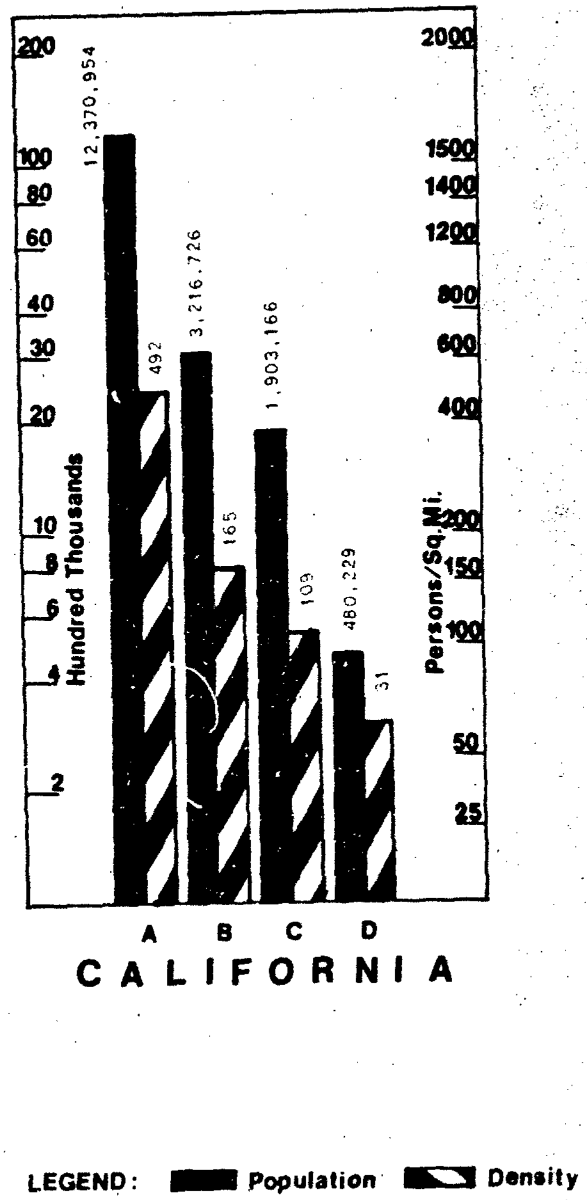

Fig.6.3 Population and Density by Coastal Zone—Pacific Coast
CALIFORNIA

only secondary roads which traverse the coastal range of mountains. Generally, due to the mountain ranges, travel in the East-West direction is more tedious and time consuming than the North-South direction. Each of the focal cities have extensive freeway systems in the immediate area of the city linking them with other points. All three cities are serviced by railroad and have airports which will accommodate jet aircraft. There is also extensive ocean shipping from other parts of the world along with intercoastal shipping from port to port.

Existing development trends.

161. The Pacific Coast Region consists of 20 SMSA's within the 100 mile range from the coast. The development trend has been an outward expansion into the urban fringes of the existing cities consistent with the availability of services and accessibility. The general policy of the region is to maintain an optimum level population, density and distribution pattern to improve the quality of life. By the year 2000, it is expected that the population will increase by approximately 100%. This suggests that it will be necessary to create facilities in the next 25 years to accommodate this increase approximately equal to that which has previously been built in the past 200 years. Interpretation of available data indicates that substantial growth and development will continue throughout the Pacific Coast Region since the average increase is approximately 36% for the past ten years.

Availability of Dredged Material.

Supply.

162. The bulk of dredged material is derived from Corps of Engineers and Port Authority projects. These dredging projects are conducted for maintenance and new work in deepending or widening existing navigational channels, harbors, rivers, and other port facilities. Quantities dredged annually are listed on Table 6.2 for the main harbors of the Region under maintenance and new work programs. Table 6.3 shows the sources of dredged material within the Districts, and Table 6.4 gives general physical characteristics for maintenance dredging material.

Demand.

163. <u>Awareness of availability.</u> In general, all of the agencies contacted (Port Authorities, City and Regional Planning Departments, Departments of Transportation, Chambers of Commerce, Economic Development and Planning Groups) were aware of the availability of dredged material. They were less aware of the quantities and quality involved. However, most were reluctant regarding its use because of possible pollutants, transportation costs, and other sundry limitations. It is necessary to conduct studies which would actually define the problems encountered with disposal such as pollutants, economic feasibility, character and nature of the dredged material. Once this is known, the different agencies should be contacted in regard to the quality and availability.

164. <u>General requests for materials.</u> Requests for material are somewhat proportional to the material quality. Where the quality of the material is good (as from the Columbia River) requests for the dredged material are frequent. Where the material quality is poor (as from San Francisco Bay and the Port of Seattle) relatively few requests were reported. The material dredged from the Columbia River is primarily a very fine non-polluted clean sand. At Portland, dredged material from the river can be used anywhere as a good clean fill. In the low lying areas along the River where fill is required, dredged material is pumped from the river and placed in the fill site. In the Columbia River area, interested parties may request dredged material through the Corps of Engineers. There are no fees involved in these transactions. The Corps will deposit the dredged material at a convenient location for removal by the applicant.

165. The Portland District Office of the Corps meets twice a year with all interested city and state departments with regard to the disposition of dredged material. These meetings result in determining beneficial uses of the material as well as disposal procedures. The Corps gives Federal Agency requests first priority followed by state, county, local, industry, and private interest in that order.

166. In the Seattle area, requests for dredged material are made through the Corps of Engineers. One project along the Duwamish River, the Corps was able to coordinate the timing of dredging with an urban renewal project. The fill material was requested by local concerns for urban development. One of the problems with this type of request is the need to coordinate applicant's construction schedules with the dredging schedule of the Corps. In the Seattle area along the Duwamish River, a private venture requested that the Corps stockpile dredged material on a site leased from the Seattle City Light Utility Company. The private venture sells this material for fill and pays Seattle City Light royalties. The material must be removed within two years; however, the Corps is contemplating this procedure for use on permanent basis. The State Department of Transportation often requests dredged material for embankment fill. Timing and coordination is also critical for these projects. Generally these requests are accommodated by stockpiling the material at a convenient location to both the user and the Corps.

167. In the San Francisco area, generally few requests for dredged material are made. The State Department of Transportation uses sandy dredged material from the Sacramento River for highway embankments. This material is stockpiled for this purpose. Other requests come from firms who are interested in experimentation with the material; however, quantities involved are usually small. Crossover Systems, Inc. of San Francisco is presently conducting experiments with dredged material regarding the extraction of metals and minerals. Another firm is experimenting with aeration as a means to speed drying time.

Limitations affecting use of dredged material.

168. Economics. The economics of transporting, cleaning and grading are not known in regard to dredge material. Because the cost of disposal is directly proportional to the length of haul and also to the number of times it has to be handled, disposal sites should be chosen within a reasonable proximity to the point of dredging. Along with this the cost would fluctuate because of the type of equipment used, loading and unloading, time of trip and also because of the physical characteristics of the dredged material, whether it is easily

pumped, etc. One factor which can help defray the costs of disposal would be in the newly created lands. Much of the time filling of lands will increase the use and also the potential value. The actual return in money derived from this newly created land would be determined by many factors, ultimate use, tax rate, initial value of the land itself, time it would take before land is useful, and the final value of the land. Properly planned and designed disposal could possibly result in an actual profit as opposed to present methods.

169. International Engineers is presently conducting a study for the Corps of Engineers which deals with many of the factors listed above.[6.17.] The study is to determine the optimum land disposal system and economic feasibility of same for the San Francisco Bay Area. The study is to cover land disposal sites as far as 60 miles inland. Transportability of dredgings is one limiting factor involved in upland disposal of the material. The cost of upland disposal is directly proportional to the distance it has to be moved and also to the number of times that it has to be handled. Probably the least expensive operation for transporting the material would be pumping. This method is generally limited to distances of 15,000 feet but the material could be transported greater lengths by using booster stations along the way. Pumping operations have limitations in that they would have to cross roads and other obstacles in route. Pumping also transports a large volume of water along with the dredged material which becomes an additional disposal problem and cost. A second mode of transportation would be to pump the dredged material to a stockpile site, allow it to dry and then transport by truck to points farther inland. Factors affecting this type of transportation would be similar to those of the pumping, mainly length of haul, elevation, topography, and also increased handling. Sites within a few miles of the shoreline and within a 25 mile range of the point of dredging would warrant first consideration. Also by looking for sites in the California Trough and Puget Trough which are generally lowlands, would help defray the costs of transportation as opposed to crossing the mountains.

170. There are no studies presently completed in this region which deal with economic feasibility or other problems involved in the transportation of dredged material. International Engineers is under contract to the Corps for the purpose of studying the economic feasibility of landfills in the San Francisco Bay area.

171. Quality. Another limitation affecting the use of dredged material is its quality. Where the material quality is high and free of pollutants, multiple purpose uses are generally not a problem. This is exemplified by the number of requests to the Corps for the material dredged from the Columbia River. Poor quality material, consisting of silts, clays and polluted material, is generally unwanted for landfill as well as being a problem for conventional disposal practices. Materials dredged in the San Francisco Bay are being tested for pollutants prior to disposal. It is classified into three catagories, non-polluted, polluted with metals, and polluted with minerals. Once classification is determined, it is then placed in a disposal area for this specific type of material. Presently the Corps is using only 4 open water sites. Three of these sites are in the Bay and one is in the ocean. The theory behind bay disposal is that aquatic and marine life has already become acclimated to the pollutants involved in open water disposal such as pollutant distribution, oxygen sag, physical impact, and material release, where the material actually goes when released. To extend the usage of dredged material and make it more attractive to applicants it will be necessary to remove pollutants, clean and grade the material.

172. Environmental constraints. Environmental constraints on the disposal of dredgings are stringent. More citizen groups and public agencies are becoming concerned as to the current and past practices of filling coastal lands for any reason. Controls on disposal practices have stopped or curtailed many dredging projects. The state of Washington has recently passed a Shorelines Management Act.[6,7] This covers disposal and filling of all lands within 200 yards of any state waterway. Along with this, the Environmental Protection Agency requires that an Environmental Impact Statement be prepared prior to approval of disposal project. These two requirements generally demand exhaustive studies pertaining to each disposal site and have stopped questionable projects.

173. The State of Oregon presently does not have legislative limitations but they expect to have such control soon. Disposal of dredgings is permitted anywhere along the coast as long as it is deposited below the high water line. Along the Columbia River, however, compliance with the Washington Shorelines Management Act is required.

174. The Bay Conservation and Development Commission (BCDC) is active in the San Francisco area. This agency has jurisdiction over construction on lands bordering the Bay within 100 feet of mean high water.[6.15] BCDC will allow filling in its specific areas only when the benefits derived from such filling will exceed the public detriment from loss of water areas. The new areas created would have to be set aside for water related uses such as ports, airports, bridges, wildlife habitat, and water related industries or recreation. Before processing permits, BCDC solicits statements from other concerned groups, State Lands Commission, State Department of Fish and Game, Regional Water Quality Control Board and also the U.S. Army Corps of Engineers. Water used to transport material in pumping operation, if it is returned to the bay, would be subject to waste discharge requirements as outlined by the Regional Water Quality Control Commission. Federal environmental impact statements are not required for projects except those that involve federal funding. Local projects require State Environmental Impact Statements.

175. Other limitations. Other limitations include the general negative outlook in considering dredged material as a resource. Most agencies contacted felt that pollution and transportation costs would inhibit most uses. In the San Francisco Bay area, many concerned groups are opposed to any filling of the Bay shoreline whatever and the Corps of Engineers is therefore confined to use 4 open water sites. Not all of the dredged material is polluted, this non-polluted material could be utilized. However, most local agencies are unaware of the actual quality of the materials being dredged. The polluted dredge material could be sanitized and metals removed and then its uses will not be so prohibitive.

Regional Landfills.

Sampling of landfill projects.

176. Matrix 6A is designed to compare a sampling of existing and proposed uses of dredged material. Tables 6.5 through 6.7 summarize data presented in this Matrix. This sampling was then related to the specific 25 mile zones as shown in Figure 6.1. Each use was related to its distance from its own respective source of dredged material and not necessarily from the focal city in the region. From these values, a mean value was calculated for each of the four land use developments: urban, environmental, economic and resource. These values are plotted on graphs for each focal city of Seattle, Portland, and San Francisco. (See Figure 6.4). It is clearly evident from the graphs that existing uses are confined to the first 25 mile zone and that only potential uses extend the graph beyond Zone A. A graph of the population for the Pacific Coast Region would follow this same slope however.

Potential Landfill Projects.

177. Matrix 6B is designed to compare a selected group of potential land uses where landfill is generally required for the Pacific Coast Region. Values were placed on these specific uses from 3 to 1. A value of 3 would have the greatest potential, 2 would have a moderate potential, and a value of 1 would have the least potential. Affecting these allotted values were factors which pertained to the Pacific Coast Region such as population density, topography of the region, known areas of expansion and also distance from the source. The matrix is divided into four divisions of potential landfills: urban, economic, environmental and resource. It is further divided into 25 mile increments as designated by columns "A" through "D" which are the coastal zones shown in Figure 6.1. From these values, a mean value was calculated for each land use development category and a mean value for the combination of all four categories. These values are plotted on graphs in Figure 6.5 for each focal city along the Pacific Coast.

MATRIX 6A

SAMPLING OF LANDFILL PROJECTS		USACE DISTRICTS - COASTAL ZONES											
		SEATTLE				PORTLAND				SAN FRANCISCO			
		A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS — URBAN	RESIDENTIAL; HOUSING	3	-	-	-	3	-	-	-	3	-	-	-
	COMMERCIAL	3	-	-	-	3	-	-	-	3	-	-	-
	RESORTS: COMMERCIAL CAMPS	-	-	-	-	-	-	-	-	-	-	-	-
	COMMUNITY FACILITIES	-	-	-	-	3	-	-	-	3	-	-	-
	MEAN	1.5	0	0	0	2.2	0	0	0	2.2	0	0	0
ECONOMIC	INDUSTRIAL	3	-	-	-	3	-	-	-	3	-	-	-
	RAIL; RAPID TRANSIT	-	-	-	-	-	-	-	-	-	-	-	-
	AIRPORTS	3	-	-	-	3	-	-	-	1	-	-	-
	HARBORS: PORTS	3	-	-	-	3	-	-	-	3	-	-	-
	HIGHWAYS	3	-	-	-	3	-	-	-	3	-	-	-
	UTILITIES	3	-	-	-	3	-	-	-	-	-	-	-
	MEAN	2.5	0	0	0	2.3	0	0	0	1.6	0	0	0
ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	1	-	-	-	3	-	-	-	3	-	-	-
	MARINE NURSERIES	1	-	-	-	3	-	-	-	-	-	-	-
	BEACH NOURISHMENT	3	-	-	-	3	-	-	-	3	-	-	-
	PARKS & RECREATION: PUBLIC	3	-	-	-	3	-	-	-	3	-	-	-
	MARSHLAND MANAGEMENT	3	-	-	-	3	-	-	-	3	-	-	-
	SANITARY LANDFILLS	1	-	-	-	3	-	-	-	1	-	-	-
	OTHER LANDFILLS	-	-	-	-	1	-	-	-	-	1	1	-
	FLOOD PLAIN CONTROLS/LEVEES	2	1	-	-	3	-	-	-	3	-	-	-
	MEAN	1.7	0.1	0	0	2.7	0	0	0	2.0	0.1	0.1	0
RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	3	-	-	-	1	-	-	-
	AGRICULTURAL/GRAZING LAND	1	1	1	1	1	1	1	-	3	-	1	-
	FORESTRY	-	-	-	-	-	-	-	-	-	-	-	-
	BRICK MFG.; CERAMICS, ETC.	-	-	-	-	-	-	-	-	1	-	-	-
	LAND RECLAMATION	3	-	-	-	3	-	-	-	-	-	1	-
	SAND & GRAVEL	3	-	-	-	3	-	-	-	3	3	-	-
	MATERIAL STOCKPILES	3	-	-	-	3	-	-	-	3	-	-	-
	MEAN	1.8	0.1	0	0.1	1.8	0.1	0	0	1.5	0.4	0.3	0
	MEAN VALUES	1.9	0.1	0	0	2.3	0	0	0	1.8	0.1	0.1	0

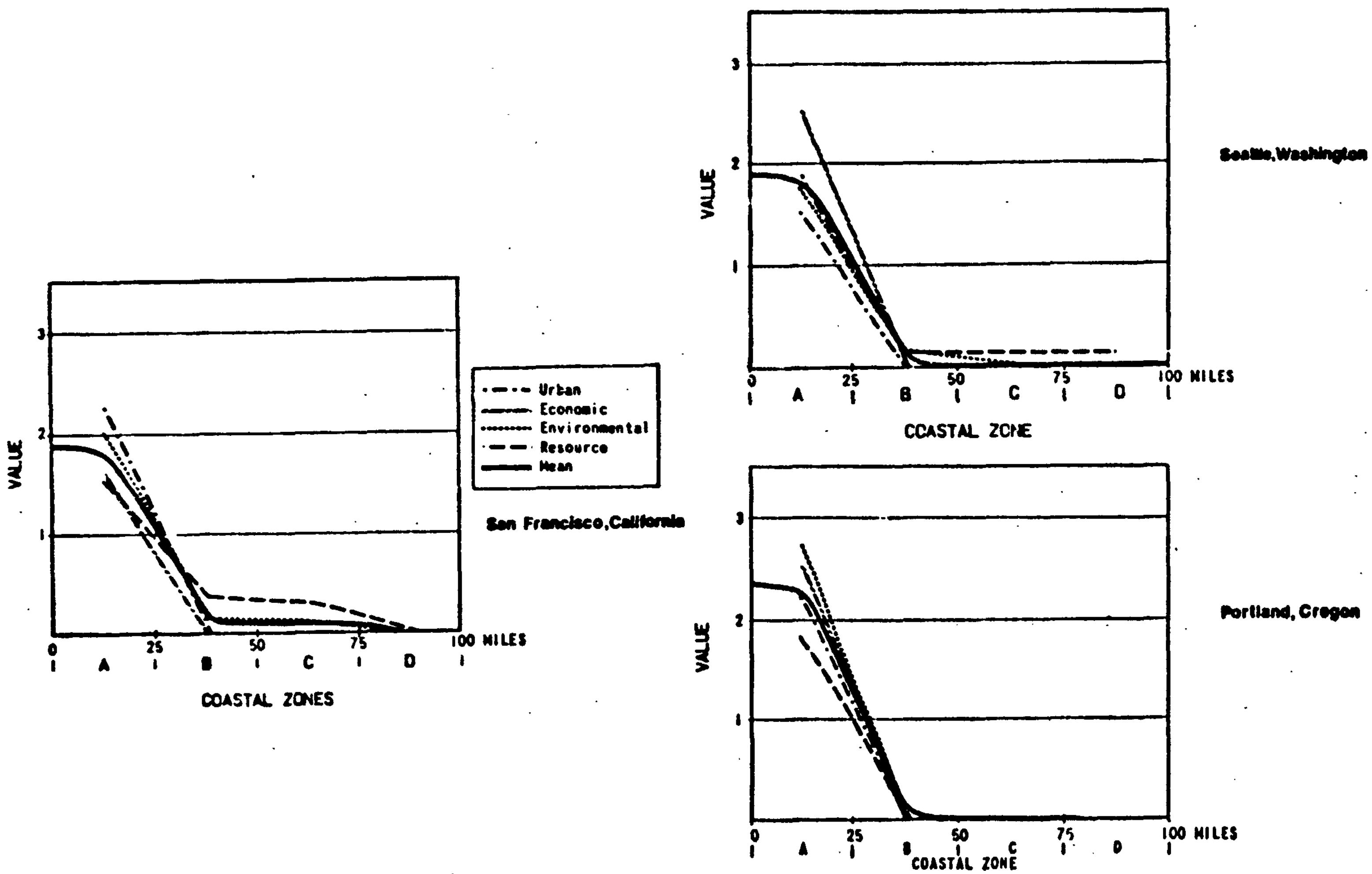

Fig. 6.4 Existing Landfill Projects
MATRIX 6A

MATRIX 6B

		POTENTIAL LANDFILL PROJECTS	USACE DISTRICTS - COASTAL ZONES															
			SEATTLE				PORTLAND				SAN FRANCISCO							
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL: HOUSING	3	1	-	-	3	2	1	-	3	2	2	-				
		COMMERCIAL	3	1	-	-	3	2	-	-	3	2	2	-				
		RESORTS: COMMERCIAL CAMPS	3	2	1	1	3	2	1	1	3	2	2	1				
		COMMUNITY FACILITIES	3	1	-	-	3	2	-	-	3	2	2	-				
		MEAN	3.0	1.2	0.25	0.25	3.0	2.0	0.5	0.2	3.0	2.0	2.0	0.2				
	ECONOMIC	INDUSTRIAL	3	1	-	-	3	2	-	-	3	2	2	-				
		RAIL: RAPID TRANSIT	3	-	-	-	3	2	-	-	3	2	2	-				
		AIRPORTS	3	2	-	-	3	2	-	-	3	2	1	-				
		HARBORS: PORTS	3	-	-	-	3	-	-	-	3	-	-	-				
		HIGHWAYS	3	2	1	1	3	2	1	1	3	2	1	1				
		UTILITIES	3	2	-	-	3	2	-	-	3	2	2	-				
		MEAN	3.0	1.2	0.25	0.2	3.0	1.6	0.2	0.2	3.0	1.6	1.3	0.2				
	ENVIRONMENTAL	WILDLIFE REFUGES: ROOKERIES	3	-	-	-	3	-	-	-	3	-	-	-				
		MARINE NURSERIES	3	-	-	-	3	-	-	-	3	-	-	-				
		BEACH NOURISHMENT	3	-	-	-	3	-	-	-	3	-	-	-				
		PARKS & RECREATION: PUBLIC*	3	3	2	1	3	3	1	1	3	2	2	1				
		MARSHLAND MANAGEMENT	3	-	-	-	3	-	-	-	3	1	-	-				
		SANITARY LANDFILLS	3	2	1	1	3	3	1	1	3	2	2	1				
		OTHER LANDFILLS	2	3	-	-	3	2	-	-	1	3	2	-				
		FLOOD PLAIN CONTROLS/LEVEES	3	3	-	-	3	2	-	-	3	2	-	-				
		MEAN	2.6	1.3	0.3	0.2	3.0	1.2	0.2	0.2	2.8	1.2	0.8	0.3				
	RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	3	-	-	-	3	-	-	-				
		AGRICULTURAL/GRAZING LAND	3	2	1	3	3	3	-	-	-	3	2	-				
		FORESTRY	1	3	3	2	3	3	2	1	3	-	-	1				
		BRICK MFG.: CERAMICS, ETC.	3	1	-	-	3	3	-	-	3	2	2	-				
		LAND RECLAMATION	3	2	-	-	3	2	-	-	3	3	-	-				
		SAND & GRAVEL	3	2	-	-	3	3	-	-	3	2	2	-				
		MATERIAL STOCKPILES	3	3	1	-	3	2	-	-	3	2	2	-				
		MEAN	2.7	1.9	0.7	0.7	3.0	2.3	0.3	0.1	2.5	1.7	1.1	0.1				
		MEAN VALUES	2.8	1.3	0.3	0.3	3.0	1.8	0.3	0.2	2.8	1.6	1.3	0.2				

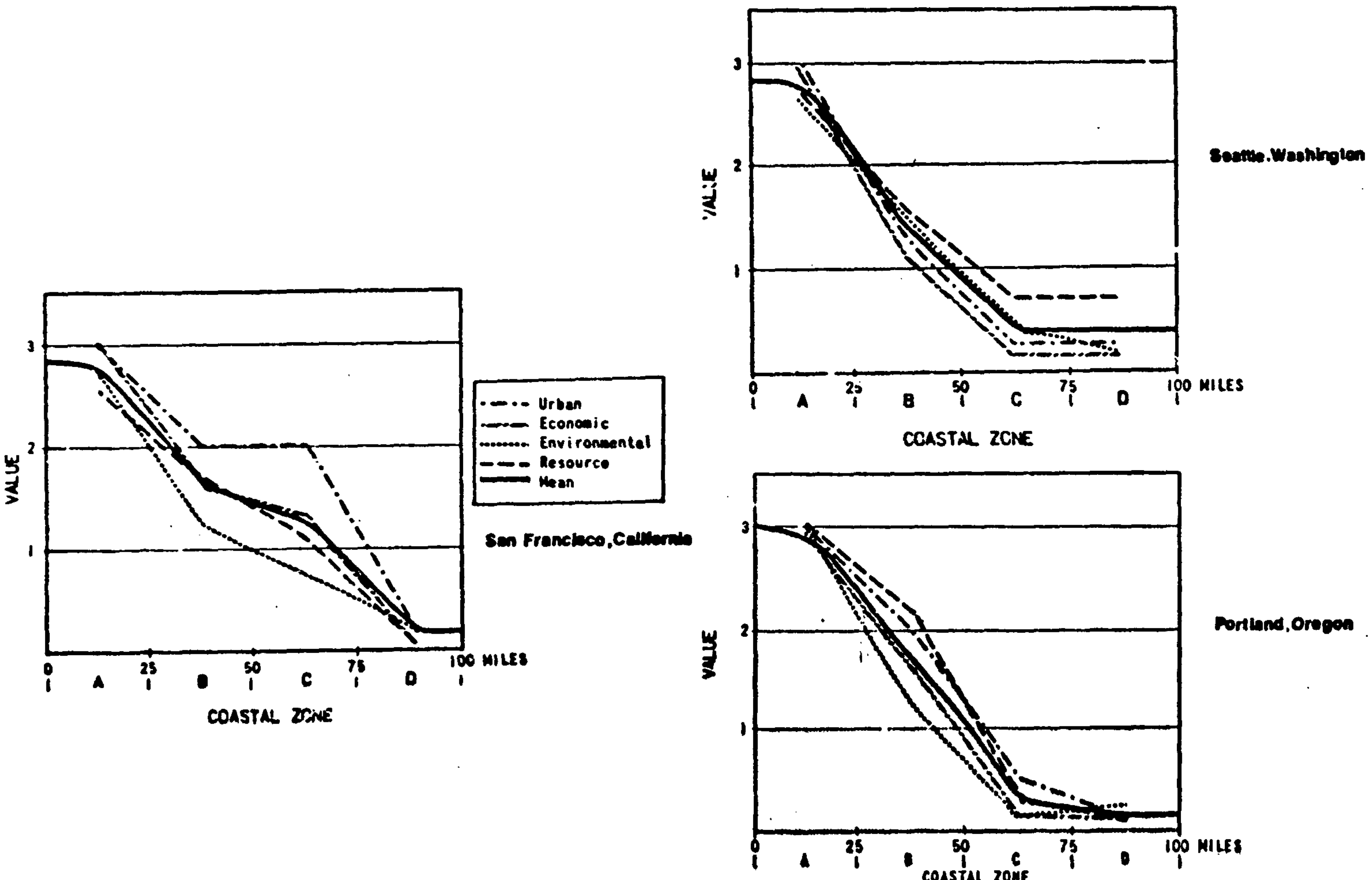

Fig8.1 Potential Landfill Projects
MATRIX 6B

Quantitative assessment.

178. Matrix 6C is designed to provide a quantitative assessment of dredged material which could be utilized for specific uses related to the four primary land use developments of urban, economic, environmental, and resource. Values have been placed on the uses from 3 to 1. A value of 3 would denote an assessment of over 2,500,000 million cubic yards. A value of 2 would be for an assessment of from 500,000 cubic yards to 2,500,000 cubic yards and a value of 1 would be an assessment less than 500,000 cubic yards. The matrix is also divided into 25 mile increments as designated by columns "A" through "D" which are the coastal zones designated on Figure 6.1. From these values, a mean value was calculated for the four land use categories and a mean value for the combination of each. These values are plotted on Figure 6.6 for each focal city along the Pacific Coast.

Example projects.

179. In all three Pacific Coast focal cities, Seattle, Portland, and San Francisco, many areas along the coastline have been filled with and developed on dredged material. This filling was conducted for either of the following: in the immediate proximity of the dredging site and on low lying marshland and swamps. These areas were filled to create new lands with specific projects in mind, such as urban or industrial development, or they were later developed because the land was available. In Seattle, early demands for fill were so extensive not only dredged material was used, but also the surrounding hills were sluiced down to provide the required amount for land development. However, within the past 10 years uncontrolled filling has ceased. No longer is it possible to fill coastal areas without review and approval. Environmental groups such as the Environmental Protection Agency, Conservation and Development Commissions, and respective city and state departments have imposed stringent controls over disposal of dredged material used for adjacent coastal landfill. The three state region has experienced a variety of uses on filled lands. Much of the Port facilities are built on filled area. It has provided urban and industrial sites, roadway embankments, dikes, rookeries, parks and recreational areas, beach nourishment, as a source of sand and gravel and stockpiled for resale. Some specific examples follow.

MATRIX 6C

QUANTITATIVE ASSESSMENT			USACE DISTRICTS - COASTAL ZONES															
			SEATTLE				PORTLAND				SAN FRANCISCO							
			A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
LAND USE DEVELOPMENTS	URBAN	RESIDENTIAL; HOUSING	3	1	-	-	2	1	1	-	2	2	2	-				
		COMMERCIAL	2	1	-	-	1	1	-	-	2	1	1	-				
		RESORTS; COMMERCIAL CAMPS	1	1	1	1	1	1	1	1	1	1	1	1				
		COMMUNITY FACILITIES	1	1	1	-	1	1	-	-	1	1	1	-				
		MEAN	1.7	1.0	0.5	0.2	1.7	1.0	0.5	0.2	1.5	1.2	1.2	0.25				
	ECONOMIC	INDUSTRIAL	3	2	-	-	3	1	-	-	3	2	2	-				
		RAIL; RAPID TRANSIT	3	-	-	-	3	2	-	-	1	1	1	-				
		AIRPORTS	2	3	-	-	2	2	-	-	1	2	2	-				
		HARBORS; PORTS	3	-	-	-	3	-	-	-	1	-	-	-				
		HIGHWAYS	1	1	1	1	1	1	1	1	1	1	1	1				
		UTILITIES	2	2	-	-	2	2	-	-	2	2	2	-				
		MEAN	2.3	1.3	0.2	0.2	2.3	0.7	0.2	0.2	1.8	1.3	1.3	0.25				
	ENVIRONMENTAL	WILDLIFE REFUGES; ROOKERIES	3	-	-	-	3	-	-	-	3	-	-	-				
		MARINE NURSERIES	1	-	-	-	1	-	-	-	1	-	-	-				
		BEACH NOURISHMENT	1	-	-	-	1	-	-	-	1	-	-	-				
		PARKS & RECREATION: PUBLIC	2	2	1	1	2	1	1	1	2	2	2	1				
		MARSHLAND MANAGEMENT	1	-	-	-	1	-	-	-	2	[illegible]	-	-				
		SANITARY LANDFILLS	2	1	1	1	3	1	1	1	2	2	2	1				
		OTHER LANDFILLS	2	2	-	-	3	1	-	-	1	2	2	-				
		FLOOD PLAIN CONTROLS/LEVEES	3	1	-	-	2	1	-	-	3	3	-	-				
		MEAN	1.8	0.7	0.2	0.2	2.2	0.5	0.2	0.2	1.8	1.2	0.7	0.25				
	RESOURCE	ARTIFICIAL ISLANDS	3	-	-	-	3	-	-	-	3	1	-	-				
		AGRICULTURAL/GRAZING LAND	1	2	2	3	2	1	-	-	-	2	2	-				
		FORESTRY	1	1	1	1	1	1	1	1	1	1	1	1				
		BRICK MFG.; CERAMICS, ETC.	1	1	-	-	1	1	-	-	1	1	1	-				
		LAND RECLAMATION	3	1	-	-	2	2	-	-	1	1	-	-				
		SAND & GRAVEL	2	1	-	-	3	1	-	-	1	2	2	-				
		MATERIAL STOCKPILES	2	1	1	-	2	2	-	-	2	2	2	-				
		MEAN	1.8	1.0	0.5	0.1	2.0	1.1	0.1	0.1	1.85	1.5	1.0	[illegible]				
		MEAN VALUES	1.9	1.0	0.3	0.3	2.1	0.8	0.3	0.2	1.7	1.3	1.0	0.2				

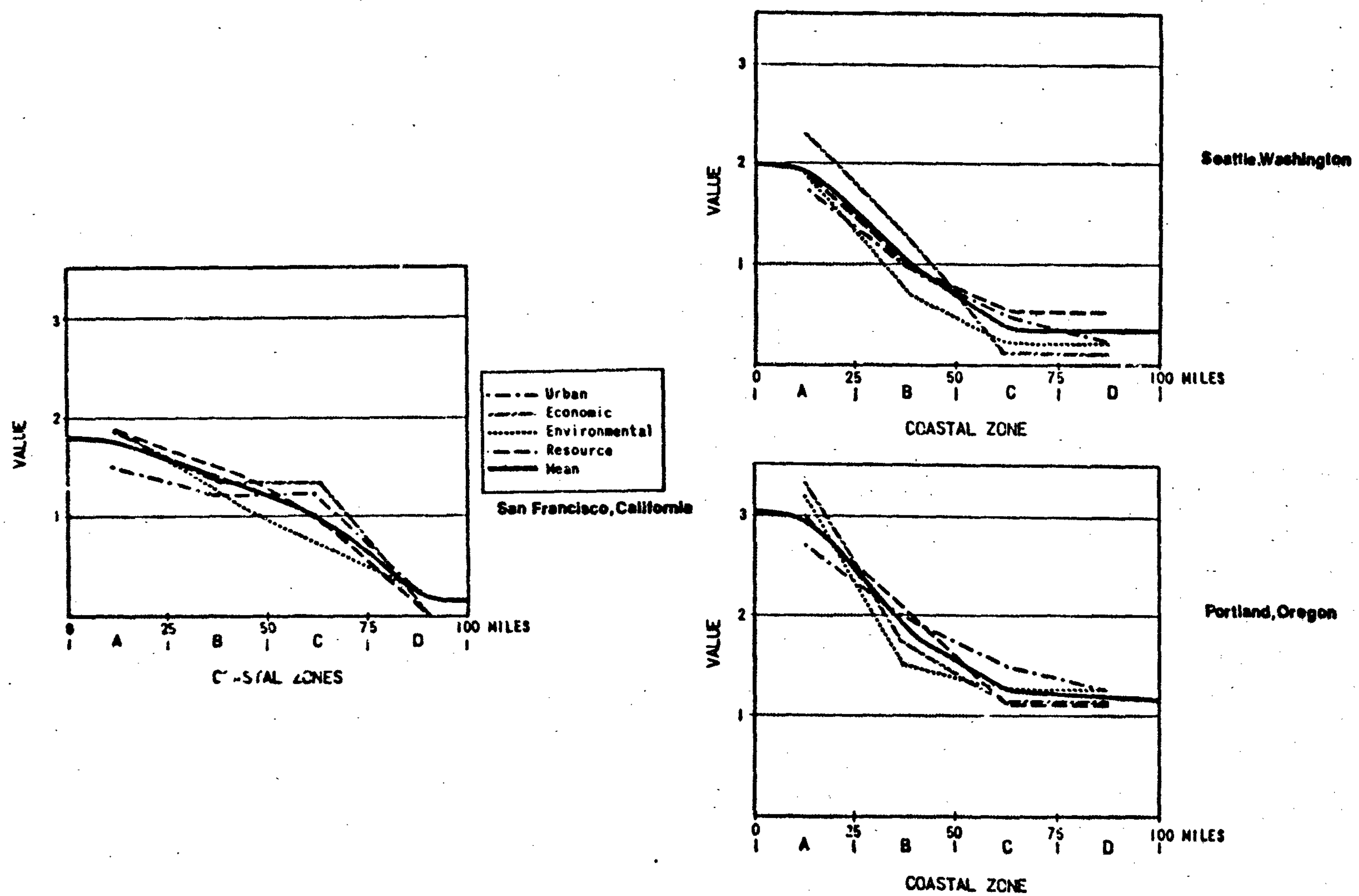

Fig.6.6 Quantitative Assessment
MATRIX 6C

180. The Washington State Department of Natural Resources maintains an 8 acre tract of State school land as a flood plain management disposal site. The site lies downstream from the Interstate 5 b-'ge across the Snohomish River. The Corps of Engineers is maintaining a settling basin for material carried along with the flow of the river. By intercepting this material (primarily sand and silt), it is kept from entering the main navigational channel and subsequently prevents reducing the depth of the channel. This material must be dredged out periodically. The purpose of the State's project is to provide a site for the dredged material and thereby accomplish three objectives: a) Preserve the utility of the Everrett waterfront and avoid negative impact to the local economy, b) Provide a 3 year period for local government to find a solution to this flood plain problem, c) Avoid loss of economy through decreased servicability of channel and increased flooding. The area involved was a former Corps of Engineers disposal site. In 1967, the Corps deposited an estimated 480,000 cubic yards of material on the site. This material was stockpiled and in the ensuing 3 year period, most of the material was utilized by the Department of Transportation in construction of highways in the proximity of the disposal site. Since material dredged from the river belongs to the state, it is proposed that any material removed from the site will be sold with the revenue to be used for paying school trust for land usage, reimburse Department of Natural Resources for diking and management costs, and also support a marine land management program.

181. Another dredged material stockpile in the Seattle area is on the City Light property. The Corps of Engineers deposited dredged material on the utility company's property which is leased to a local contractor who in turn sells the dredged material for fill. The industrial area of Shelton, Washington was developed on tidal lands with dredged material and also many of the homes were built on bulkheads and fills in the area. Foster City, California was built on dredged material fill along with parts of Candlestick Park, Hunter's Point Naval Shipyard, and many of the port facilities. Practically all of the dredged material in the Los Angeles area is committed to beach nourishment. The Port of San

Francisco is building a new pier on a former disposal site. It was found necessary to remove much of the previously dumped material due to its poor characteristics. Because of the subsidance problems, a proposed riprap dike would have been too heavy and settled into the bottom silt. It was possible to construct a dike out of paper, rubbish and debris mixed with dredged material which was light enough to prevent settling into the bay mud and also strong enough to contain the area. The dike was then lined with an outer layer of dredged material which prevented contained sulphides from leaching into the bay. In the Portland area, the material dredged has a very high quality and can be used for practically any fill project. In addition to the typical projects listed above for the other focal cities, dredged material has been used in sanitary landfill projects, parking lots, and extensions of the Portland Airport. It has been benificial in the creation of artificial islands as rookeries, a major deterent in the prevention of beach erosion, and also in the creation of new clam beds at Coos Bay and Yaguina Bay. The Willamette Hi-Grade Concrete Company is dredging in the river for materials which it uses in its concrete production. The dredged material has also been used for park development, creation of fishing beaches and also stockpiled for a variety of other uses. Figure 6.7, "Existing Landfills and Usage Along Umpqua River, Oregon" was exerpted from "Oregon's Submerged and Submersible Lands" which was a study conducted to determine the location, extent, ownership history, owner of record and use of filled lands in the Umpqua Estuary.[6.14.] It was exerpted for this report to further exemplify the varied usage of dredged material.

Sampling of landfill projects.

182. Proposed usage of dredged material parallels that of existing usage; however, with increased pressure exerted by the EPA and the recent passage of Washington's Shoreline Management Act, California's Coastal Initiative Law and anticipated passage of a similar law in Oregon, many projects have been slowed or stopped all together. A dike is proposed around South Aberdeen and Cosmopolis areas in Washington, which are subject to periodic flooding. The Camas-Washougal area along the Columbia River is proposing to have

Figure 6.7 Existing Landfill

PARCEL	OWNERSHIP		CONSTRUCTION DATES		ORIG
	PRESENT	WHEN FILLED	STARTED	COMPLETED	
1-1-2	Douglas County	Douglas County	10/62	Present	Moorage a
1-1-3	Douglas County	Douglas County	10/62	Present	Moorage s
1-1-31	Federal Gov.	Federal Gov.	10/62	10/64	U.S. Coas
1-1-32	Federal Gov.	Federal Gov.	10/62	10/64	U.S. Coas
1-14-51	Winchester Bay Seafood	Winchester Bay Seafood	10/62	10/64	Moorage a
1-14-52	Douglas County	Douglas County	10/62	10/64	Moorage a
2-MA	International Paper	International Paper	1962	1971	-
3-4	First National Bank		1942	1962	None
4-0		City of Reedsport	8/25	9/26	See Note
4-00	City of Reedsport	State of Oregon	8/25	9/26	See Note
4-505	James Devitt	James Devitt	1972	Present	None
5-0	State of Oregon	State	1942	1962	Street
5-506	Umpqua River Nav. Co.	Umpqua River Nav. Co.	1942	1962	Bldgs. an
5-509	Umpqua River Nav. Co.	Umpqua River Nav. Co.	1942	1962	Bldgs. an
5-510	Umpqua River Nav. Co.	Umpqua River Nav. Co.	1942	1962	Comm. San
5-511	Umpqua River Nav. Co.	Umpqua River Nav. Co.	12/60	11/67	Comm. San
6-53	State of Oregon	State of Oregon	After 1965		Dock
7-5.2	H. & Margaret Burton	H. & Margaret Burton		Prior To 1965	Comm. San
8-Gov. Lot 13	International Paper	-		Prior To 1965	None

Source: Second Biennial Report - Oregon's Submerged and Submersible Lands, Dec. 1972, pg. 158

NOTE /1 The tidelands of Rainbow Slough were sold to W. P. Reed on March 3, 1916. In 1925, the city of Reedsport obtained an Army Corps of Eng. permit to fill this area. Today, this area is used as public sts., industrial and commercial businesses, and private residences. The tax lots involved are listed on the detail sketch of Parcel 4-0.

Figure 6.7 Existing Landfill and Usage Along Umpqua River; Oregon

...RUCTION DATES		USAGE		PERMIT		
	COMPLETED	ORIGINAL	PRESENT	NUMBER	CLASS	SUBMERGED
	Present	Moorage and Bldgs.	Moorage and Bldgs.	285/70A-1/1,1/2,1/3 1522-15-5/1thru 5/5	Breakwater Moorage	3.33
	Present	Moorage and Bldgs.	Moorage and Bldgs.	"	"	
	10/64	U.S. Coast Guard St.	U.S. Coast Guard St.	285/70A-1/1,1/2,1/3	Breakwater & Fill	-
	10/64	U.S. Coast Guard St.	U.S. Coast Guard St.	"	Breakwater & Fill	-
	10/64	Moorage and Bldgs.	Moorage and Bldgs.	"	Breakwater & Fill	-
	10/64	Moorage and Bldgs.	Moorage and Bldgs.	"	Breakwater & Fill	-
	1971	-	None	-	-	-
	1962	None	None	-	-	.64
	9/26	See Note /1		P825.93/5a/5b/5c	Bulkhead & Fill	-
	9/26	See Note /2		P825.93/5a/5b/5c	Bulkhead & Fill	1.68
	Present	None	None	-	-	-
	1962	Street	Street	-	-	-
	1962	Bldgs. and Dock	Bldgs. and Dock	-	-	-
	1962	Bldgs. and Dock	Bldgs. and Dock	-	-	-
	1962	Comm. Sand & Grav.	Comm. Sand & Grav.	-	-	.10
	11/67	Comm. Sand & Grav.	Comm. Sand & Grav.	NPP 285/70a-7/1	Fill	2.75
65		Dock	Dock	-	-	-
	Prior To 1965	Comm. Sand & Grav.	Comm. Sand & Grav.	-	-	-
	Prior To 1965	None	None	-	-	-
					TOTALS	8.50

...n March 3, 1916.
...Eng. permit to
... industrial and
...ots involved are

NOTE /2 Rainbow Basin, the unsold submerged portion of Rainbo... at the same time the slough was filled. It is now us... called Rainbow Avenue. The deed description on the ... expressly omits the area of Rainbow Basin.

• Along Umpqua River; Oregon

SAGE	PERMIT		FILL ACREAGE		
PRESENT	NUMBER	CLASS	SUBMERGED	SUBMERSIBLE	TOTAL
Moorage and Bldgs.	285/70A-1/1,1/2,1/3 1522-15-5/1thru 5/5	Breakwater Moorage	3.33	75.40	78.73
Moorage and Bldgs.	"	"			
U.S. Coast Guard St.	285/70A-1/1,1/2,1/3	Breakwater & Fill	-	.63	.63
U.S. Coast Guard St.	"	Breakwater & Fill	-	1.00	1.00
Moorage and Bldgs.	"	Breakwater & Fill	-	.31	.31
Moorage and Bldgs.	"	Breakwater & Fill	-	1.35	1.35
None	-	-	-	.07	.07
None	-	-	.64	-	.64
	P825.93/5a/5b/5c	Bulkhead & Fill	-	15.71	15.71
	P825.93/5a/5b/5c	Bulkhead & Fill	1.68	-	1.68
None	-	-	-	.01	.01
Street	-	-	-	.17	.17
Bldgs. and Dock	-	-	-	.11	.11
Bldgs. and Dock	-	-	-	.17	.17
Comm. Sand & Grav.	-	-	.10	.42	.52
Comm. Sand & Grav.	NPP 285/70a-7/1	Fill	2.75	1.99	4.74
Dock	-	-	-	.02	.02
Comm. Sand & Grav.	-	-	-	.11	.11
None	-	-	-	.07	.07
		TOTALS	8.50	97.54	106.04

NOTE /2 Rainbow Basin, the unsold submerged portion of Rainbow Slough, was filled at the same time the slough was filled. It is now used as a city street called Rainbow Avenue. The deed description on the sale of Rainbow Slough expressly omits the area of Rainbow Basin.

a 50 acre tract of land filled with approximately 300,000 cubic yards for an industrial site. Near Port Angeles a beach nourishment program is underway to stabilize Ediz Hook which protects the port. This project will require 108,000 cubic yards of fill. In southern Washington the Parks and Recreation Board for Skamania County has proposed several improvements to parks and boat ramps in the area. Listed are 4 sites requiring fill including Wind River Boat Ramp, Rock Creek Fair and Park Grounds, Drano Lake Boat Ramp, and Big White Salmon River. These sites will require over 200,000 cubic yards of fill material.

183. A proposal prepared by the Port of Seattle regarding the deepening and widening of the Duwamish River channel briefly describes and locates 10 sites for the disposition of dredged material.[6.4]. (See Figure 6.8) The Corps of Engineers, along with the Port's Planning and Research Department, have decided that a 250 foot by 40 foot deep channel is required in the Duwamish River. The port would be the sponsor for the project and thereby is responsible for providing disposal sites. Reference to Figure 6.8 shows that sites I and IX are proposed for stockpile use where material will be deposited, allowed to dry and then transported to other areas requiring fill. Sites III and V will be developed for new port facilities. Filling these sites will create an area of 30 acres. The area at Site V is designated to be developed by the Port as an industrial park. Site VIII will require filling prior to its slated urban redevelopment.

184. Another potential use, related to sanitary landfills, was suggested that dredged material and solid waste could be mixed for reclamation of dredged tailings in California. Dredge tailings are the end product of gold mining operations, which it was mentioned have blighted 5 square miles of an area around Modesto. Figure 6.9 shows these dredge tailings around the Modesto area.

185. Reclamation of land for agricultural purposes was also proposed. In Washington it was suggested that dredged material possibly could be used as a mulch for cranberry crops. Dredged material and solid waste could also be combined and transported inland to reclaim lava "scab" land for agriculture. A typical lava area results from volcanic

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action and contains very little soil. The geographic position of areas with these deposits have a long growing season for crops and could be adopted successfully to agricultural use. Many square miles of land could be covered with dredged material as a nutrient to the "scab" land. Present costs for a project of this size would be exorbitant, but with agricultural land disappearing for other development this land resource could be extremely valuable in the future. Reclaiming of lava "scab" land was also suggested for areas along the Columbia River and Columbia River Gorge. The California Department of Transportation in San Francisco has used poor quality materials such as dredgings for embankment slopes and to contour grade interchange areas. Along the Green River Valley in Seattle, areas are being considered for development that must have a "preload fill" placed over them to compact lower strata. Dredged material could be stockpiled on these sites as preload fill. Upon completing the "preload" purpose, the stockpiled material could be removed for other landfill needs if warranted.

186. A unique example to be considered for potentially large quantities of dredged material is in the preservation of delta levees of the San Joaquin River-Sacramento River Delta. This is a low lying area with many islands and sloughs. The land is gradually subsiding and most places are below the water level in the sloughs. Present levees are built of peat and are fragile, porous and unable to sustain loads, some have been breached returning the land to the river. It is a unique eco-system with extremely rich fertile agricultural land and recreational potential. A resource recovery plan proposal has been offered by the Environmental Impact Planning Corporation in conjunction with the Associated Bay Area Governments to save the delta. The plan proposes to strengthen existing dikes by utilizing a mixture of compost and dredged material. This plan could solve two disposal problems: solid waste and dredged material. Figure 6.10 graphically illustrates the purposes of the proposal.

187. The following was extracted from a preliminary report entitled "Land Disposal of Dredge Spoils for San Francisco Bay," as prepared for the San Francisco Bay Conservation and Development Commission.[6.16]

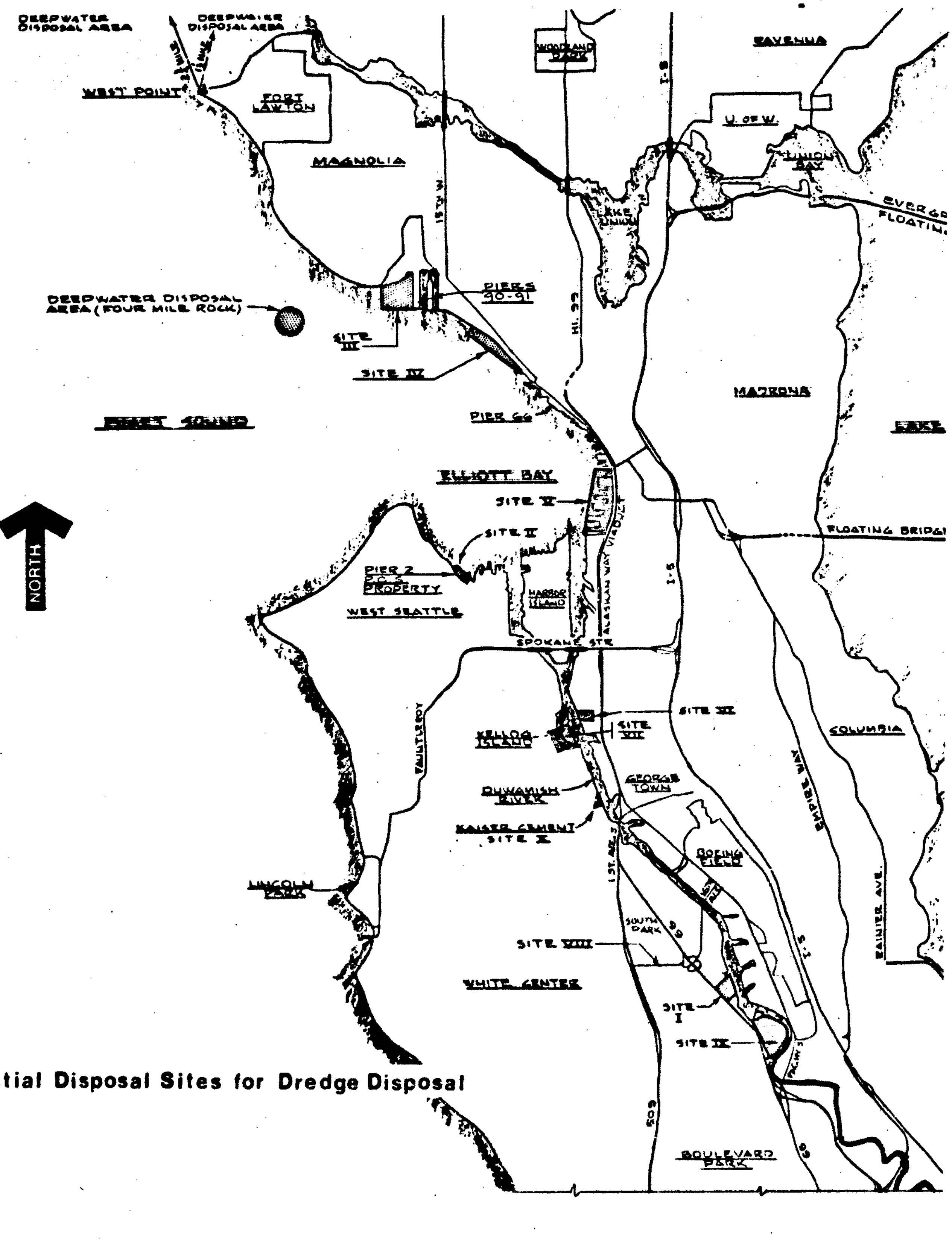
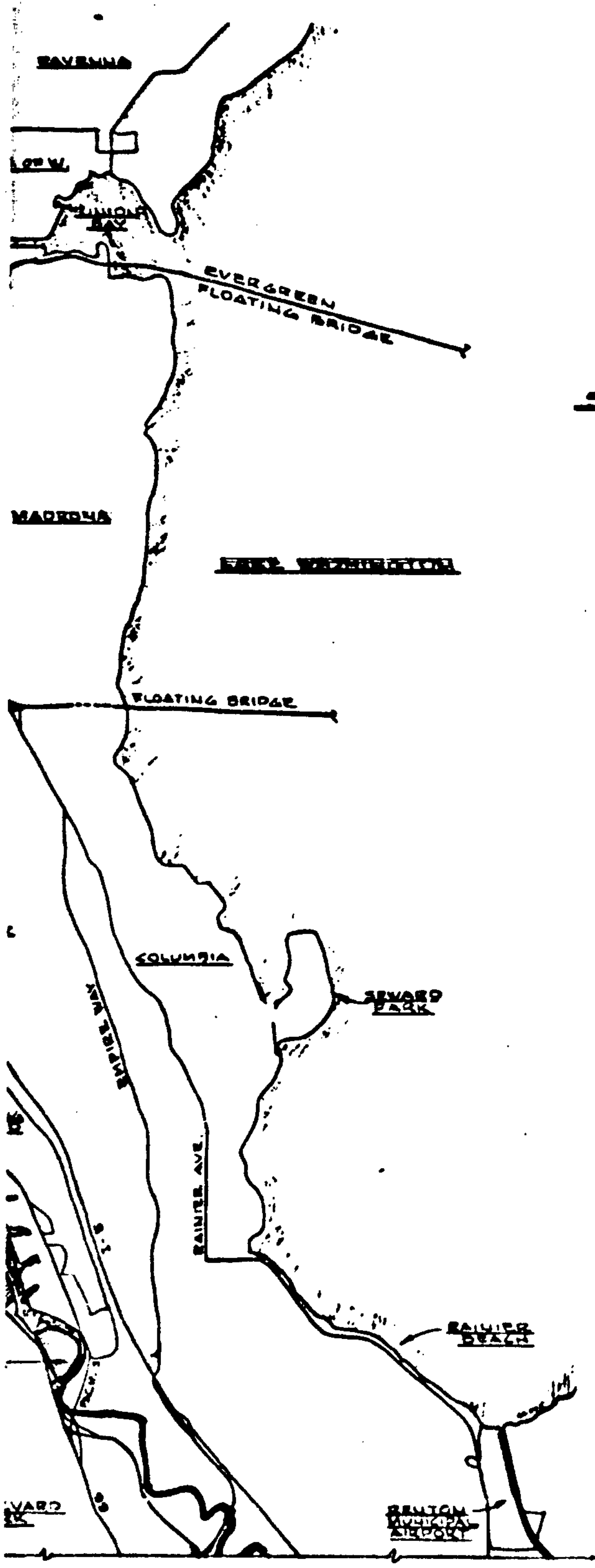


Fig.6.8 Potential Disposal Sites for Dredge Disposal



SITE	VOLUME YD³ (APPROX.)	OWNERSHIP	REMARKS
I		CITY LIGHT	STOCK PILE SITE
II	40,000	PORT OF SEATTLE	
III	1.100.000	FEDERAL GOVERMENT	THIS AREA IS PLATTED. PART OF PIERS 90-91 COMPLEX. FILLING WOULD CREATE APPROXIMATELY 30+AC OF UPLANDS.
IV	400,000	CITY OF SEATTLE DEDICATED TO STATE FOR OUTDOOR RECREATION	THIS AREA IS PLATTED. UNKNOWN IF PLANNED TO BE FILLED. WOULD NOT BE A DESIRABLE SITE FOR THE PROJECT BECAUSE OF THE LACK OF DEPTH VS FRONTAGE. DIKING WOULD TAKE A MAJORITY OF THE POTENTIAL FILL VOLUME. (300,000+YDS FOR DIKE).
V	3.100.000	PORT OF SEATTLE	THIS AREA WILL BE DEVELOPED BY THE PORT OF SEATTLE. THE PROBLEM WITH USING DUWAMISH DEEPENING DREDGED FILL IS THE TIMING. WHEN THIS PROJECT IS TO START, AND DEVELOPING IT IN STAGES WOULD IMPACT THE DUWAMISH PROJECT.
VI	UNKNOWN	CHIYODA CHEMICAL AND ENGINEERING	THIS AREA WILL REQUIRE FILLING BEFORE IT CAN BE DEVELOPED. POSSIBLE SITE FOR CORPS OF ENGINEERS 1973 MAINTENANCE DREDGING (30.000 YD³) INPUT FOR PERMITS WAS AVAILABLE AND MATERIAL SUITABLE ETC.
VII	420,000	PORT OF SEATTLE	KELLOGG ISLAND. DEVELOPMENT AS NOW PROGRAMED WILL TAKE APPROXIMATELY 420.000 YD³. THIS COULD BE INCREASED IF SEABOARD LUMBER CO. TO THE NORTH AND OR IDEAL CEMENT TO THE SOUTH WOULD AGREE TO FILLING, SOME OF THEIR SUBMERGED PROPERTY. THE AREA IS BEING CONSIDERED FOR A DISPOSAL SITE FOR DEVELOPMENT OF PIERS 19 & 20 AND THE CORPS 1973 MAINTANCE DREDGING TOTAL OF 150.000 YD³. THIS WILL LEAVE APPROXIMATELY 240.000 YD³ AVAILABLE FOR FILL.
VIII	1000,000	CITY OF SEATTLE PROGRAM (MAY NOT PRESENTLY OWN ENTIRE SITE	THE SOUTH PARK URBAN RENEWAL AREA WILL REQUIRE FILLING BEFORE IT CAN BE DEVELOPED. THIS SITE IS AN UPLAND AREA. NO DIKING REQUIRED. EXCELLENT LOCATION FOR THE DISPOSAL AREA FOR THE UPPER REACH. WILL REQUIRE REASONBLY GOOD FILL.
IX	STOCK-PILE SITE ONLY	DESIMONE ESTATE	POTENTIAL STOCK PILE SITE, HYDRAULIC DREDGE TO THIS SITE ALLOWED TO DRAIN THEN TRUCKED TO OTHER AREAS FOR FILL.
X	200.000	KAISER CEMENT	

SCALE IN MILES

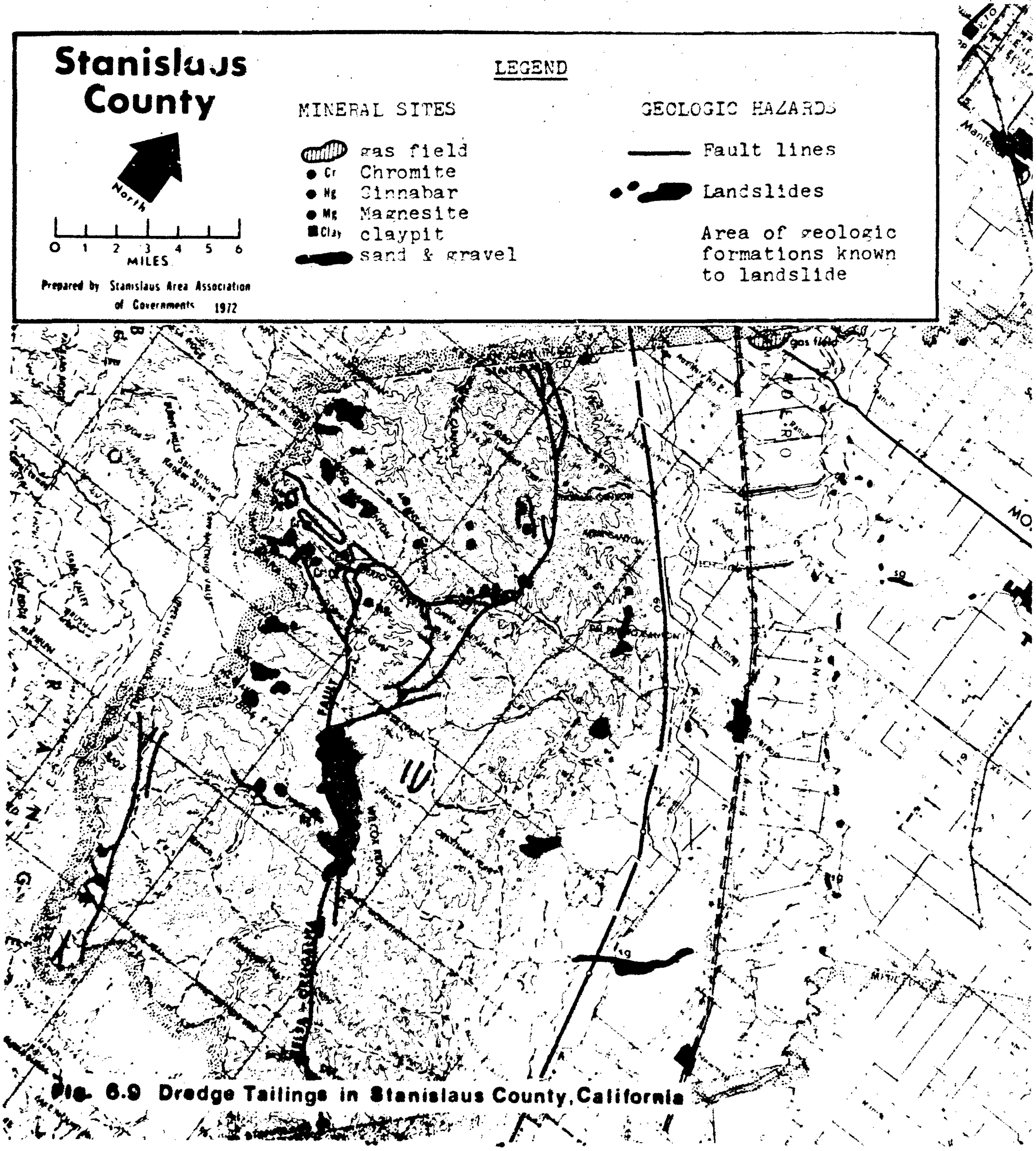


Fig. 6.9 Dredge Tailings in Stanislaus County, California

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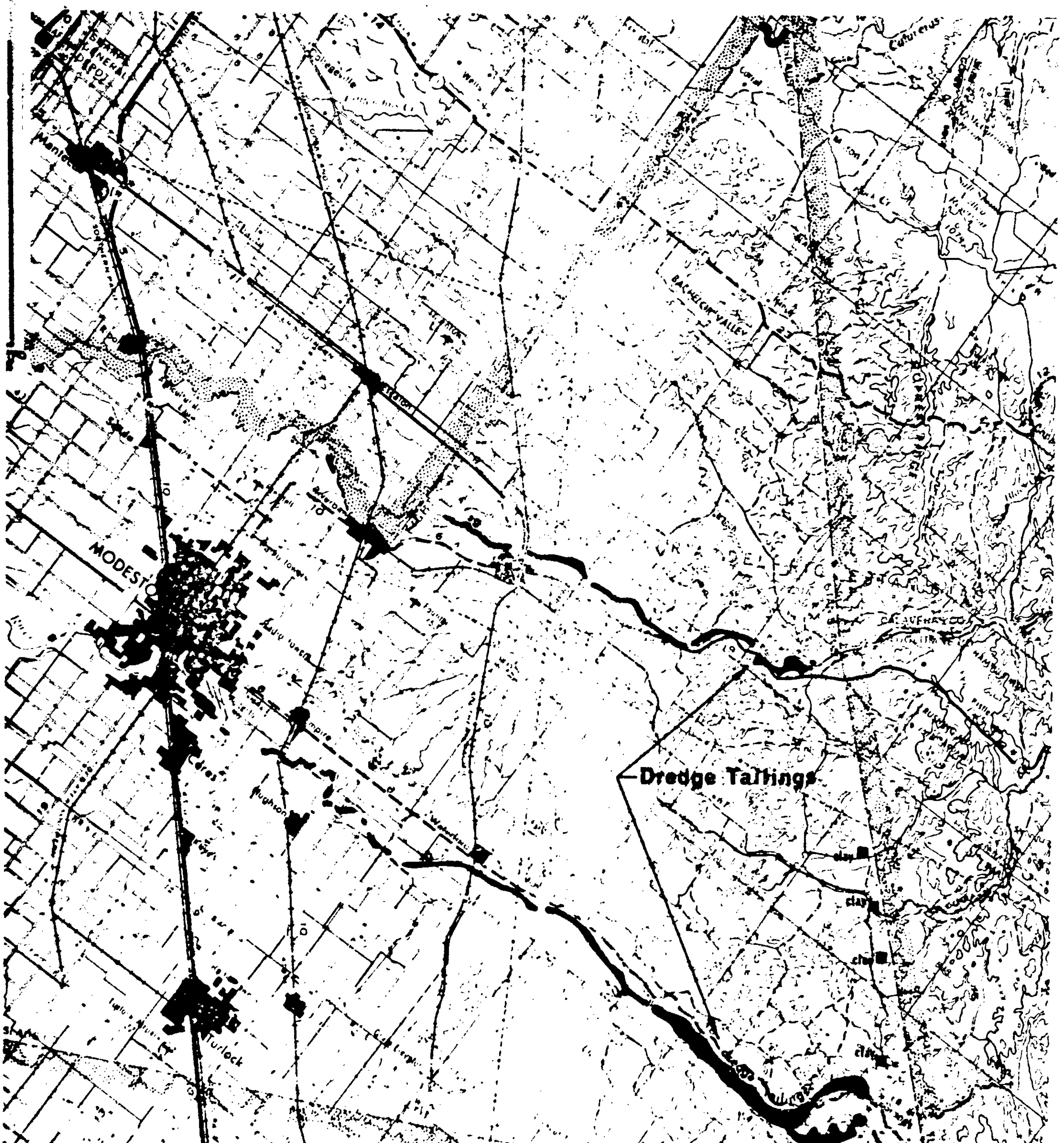
MODESTO
Dredge Tailings
Turlock
Ceres
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Empire
Salida
Manteca
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BACHELOR VALLEY
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The Bay Area need not continue to bury its solid wastes in land fills. Instead, it could start now to recover these resources and put them to beneficial use. The twelve steps involved in such a resource recovery process are the following.......

1. Deliver All Wastes To A Processing-Transfer Station

To the greatest possible extent paper, glass and metals would be kept segregated at their sources and be delivered in separate trucks.

2. Separate Out Directly Usable Materials

Returnable bottles and clean paper would be sorted out for resale and reuse, either directly or after reprocessing, as raw materials for new secondary industries.

3. Remove Ferrous Metals For Sale To Industry

Large ferrous metal objects such as stoves or car bodies would be segregated by hand. Tin cans and other small iron objects would be extracted magnetically.

4. Reduce Particle Size

Materials remaining after the above would be shredded and crushed to reduce all materials to small particles with a maximum dimension of two inches.

5. Separate Organic From Inorganic Materials

The shredded wastes would be passed through an air classifier - a device that uses a rising stream of air to lift the light organic material and leave the heavy inorganic material behind.

6. Blend In Special Wastes

Special organic wastes such as digested sewage sludge, which is high in nitrogen and water content would be blended with the main stream of shredded organic material.

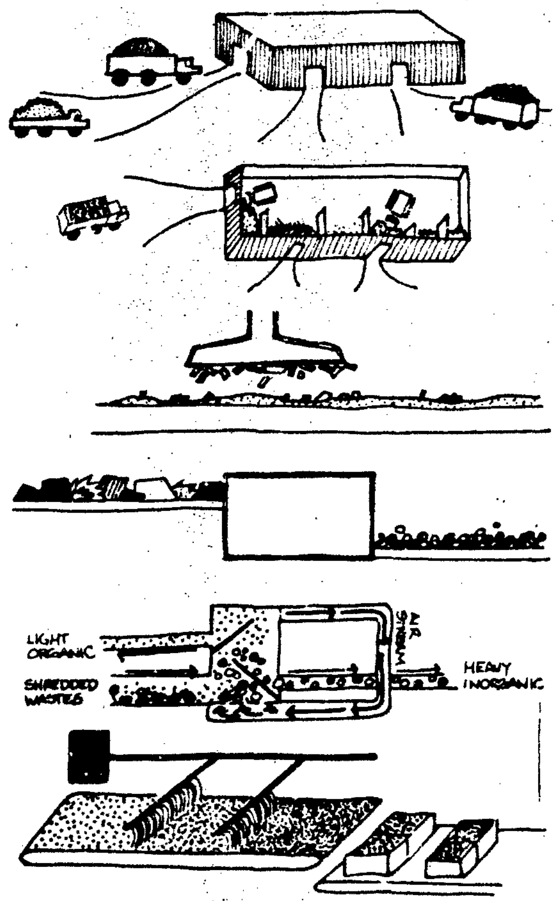

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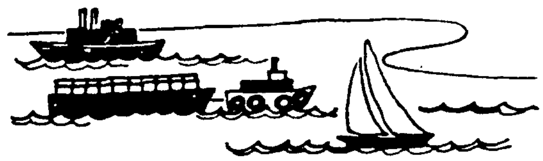
Fig. 6.10 A Resource Recovery Plan For The

7. Load Organic Wastes On Barge For Transport

Blended wastes, packaged in special containers, would be trucked to the point of embarcation and transfered to barges.

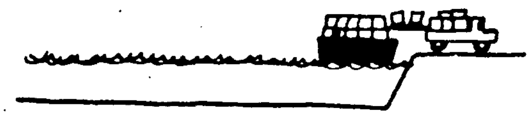
8. Transport Organic Wastes To Delta Island

Containerized organic wastes will be transported by barge from San Francisco Bay through the busy waterways of the Delta to the steadily subsiding Delta Islands.



9. Unload Organic Wastes On Delta Island

Barge unloading operations, being carried on in windy locations, would be carefully designed to minimize the scattering of wind-blown particles as well as the creation of any unsightliness.



10. Compost Organic Wastes

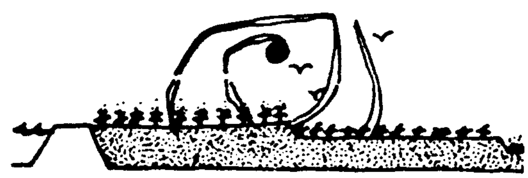
Wastes would be stacked in windrows for aerobic composting with regular turning. Composting would be continued until a stable humus has been produced. High temperatures would prevent fly breeding and rodent attraction.

11. Using Compost, Raise The Land Level Behind The Levees

Compost would be placed on the land behind the levees to a width of 500 feet, each successive layer 1 foot in depth. Each layer of compost would be followed by a layer of suitable dredger spoil and the two thoroughly mixed, to a depth of 20 feet at the levee, terracing downward toward the center of the island.

12. Plant Agricultural Crops On The New Land Surface

The nationwide importance of the entire operation is the demonstration that a soil mantle can be produced using compost, which is the equal of native soil in fertility. Hence, a three to five year period of rotating crops will be demonstrated using normal practices.



Environmental Impact Planning Corporation 319 Eleventh Street San Francisco California 94103

For The San Francisco Bay Area

"A cursory review of lands lying below 15 feet MSL and adjacent to San Pablo Bay, and the lower reaches of the San Joaquin River has revealed that there are substantial land areas that may be available for use as disposal sites for dredged material". Among the criteria used in tentatively identifying these lands as acceptable for disposal were land elevation, land use designation as shown on the San Francisco Bay Plan, and accessibility to the area where spoil is generated. Based on these criteria, nearly 19,000 acres of land were identified. The volume of material these lands can contain depends on the depth of fill and several other factors discussed in the following section on site selection. Each site must be separately analyzed, but based on the assumption that all of these lands could be filled to an elevation of 15 feet above mean sea level, their combined capacity is estimated to be 400 million cubic yards. Assuming that the dredgings will consolidate when dried to two-thirds of the shoal volume (volume of sediments in the channel), the volume of material that could be dredged from the channels and deposited on these lands would be 600 million cubic yards. This amount exceeds all the estimated dredging from the study area for more than 50 years. Based on experience in other areas, it is assumed that dredged material can be deposited, dried and compacted at a rate of 1.5 feet per year and that after drying and compaction the 1.5 feet of spoil will be one foot of fill. For every 1,000,000 cubic yards of shoal volume dredging, 413 acres of land disposal area plus 275 acres of ponding area will be required. The pond area is necessary to process the effluent from the hydraulically dredged spoil before it can be discharged back into the bay. If the average annual dredging rate during the construction of the John Baldwin Ship Channel is 11,000,000 cubic yards, approximately 4,500 acres for drying and compacting and 3,000 acres for ponding will be required. Even if 19,000 acres of land are not available for use as disposal areas, and if the areas cannot be filled to an elevation of 15 feet MSL, it is concluded that enough land does exist to consider land disposal a viable method of disposing of dredge spoils and thus worthy of further study."

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188. Although past diking and filling of San Francisco Bay has reduced the size of the Bay from 680 square miles to 400 square miles and continued filling of the Bay is to be discouraged, the San Francisco Bay Conservation and Development Commission has noted particular areas along the Bay's shoreline where fill material may be required in developing the San Francisco Bay Plan.[6.15] These areas are located on Figure 6.11 by number as listed below.

No.	Location	Potential Uses
1	Pinale Point	water related industry
2	Wilson Point Beach & Park	recreation
3	Richmond Sanitary Landfill	Environmental
4	Point Molate Beach	beach nourishment
5	Point Molate to Pt. Richmond	recreation
6	Keller's Beach to Ferry Point	beach nourishment
7	Richmond Port	water related industry
8	Albany-Berkeley-Emeryville	recreation
9	Oakland-Alameda Port Area	water related industry
10	Oakland Army Base & Naval Supply Center	industrial
11	Naval Air Station	Naval installation
12	San Leandor Bay	wildlife habitat
13	Alameda Beaches	beach nourishment
14	Dumbarton Point	recreation
15	Alviso Slough	strengthen levees
16	Park System @ Coyote Creek	recreation
17	Oyster Point	recreation and Marina facilities
18	Coyote Point Park	beach nourishment & marina
19	Burlingame	waterfront development

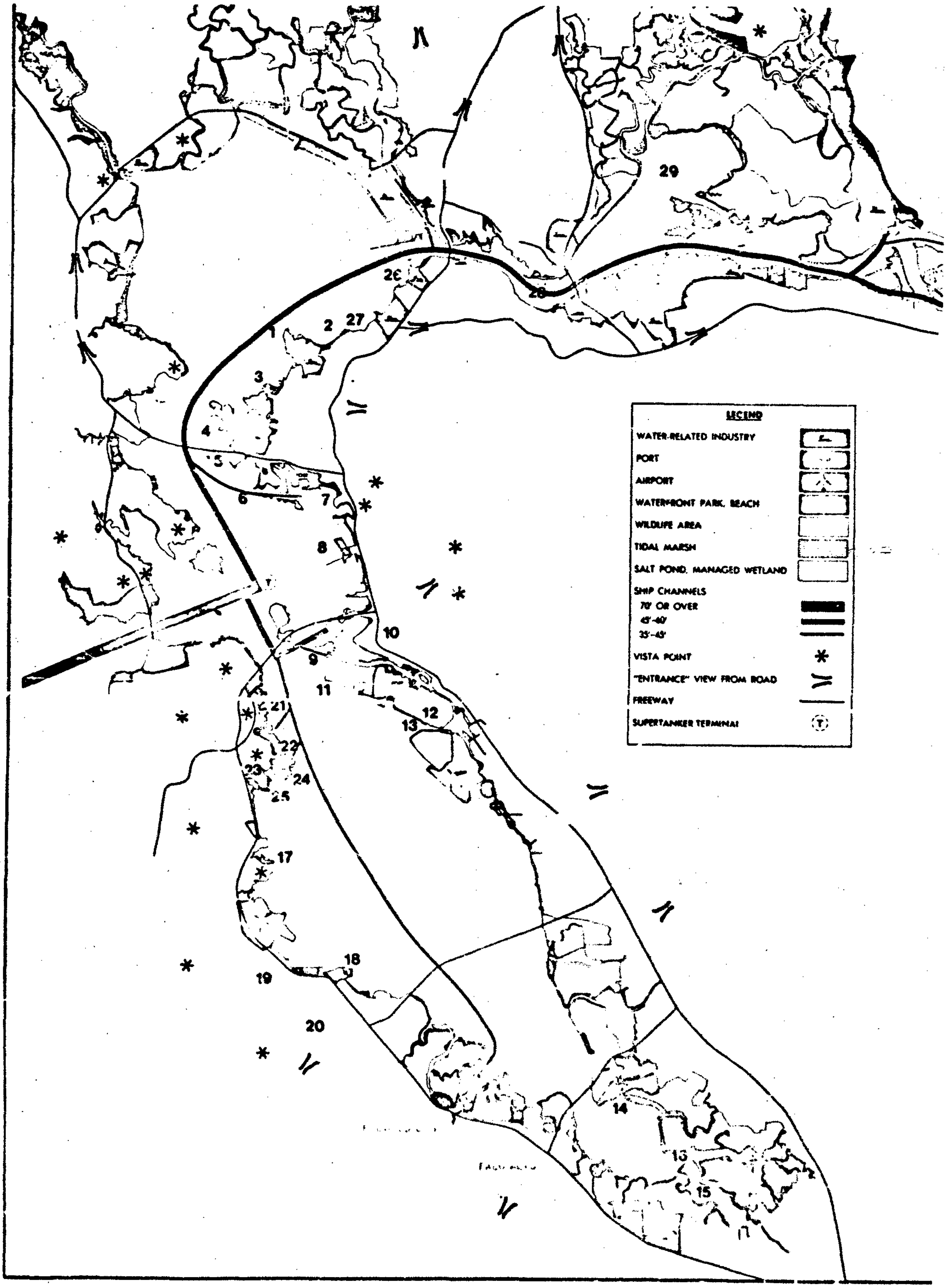

Fig.5.11 PROPOSED MAJOR USES THE BAY AND SHOREL

No.	Location	Potential Uses
20	San Mateo	water oriented recreation
21	San Francisco Port	marine terminals
22	India Basin	port and recreation
23	South Basin	
24	Hunters Point Naval Shipyard	port & industrial
25	Candlestick Point Shoreline Park	
26	Rodeo	beach nourishment
27	Wilson Point	recreation
28	Benicia Point to Army Point	port & industrial
29	Suisun, Grizzly & Honker Bay	wildlife
30	Suisun Slough Shallow Draft Port	industrial

Sample of future land use and development plans.

189. Figure 6.12 is a generalized illustration of the Columbia Region Association of Governments (CRAG) regional land use plan surrounding the Portland area. Figure 6.12 also identifies areas of potential dredged material utilization. These areas are designated by the symbols En (Environmental), U (Urban), and Ec (Economic) which indicate the recommended use of the land after filling.

190. The Clark County Parks Department is developing a park site at Reed Island and also on the west side of Vancouver Lake. These areas are designated En on Figure 6.12. The latter of which will utilize approximately 20,000 cubic yards of material from nearby dredged stockpiles. In the same area west of Vancouver, the Corps of Engineers, Port of Vancouver and Clark County are proposing to dike and fill an area for industrial development adjacent to the Columbia River-Vancouver Lake lowlands, noted Ec on Figure 6.12. This will utilize dredged material both from the River and Vancouver Lake to create an area of approximately 5800 acres.

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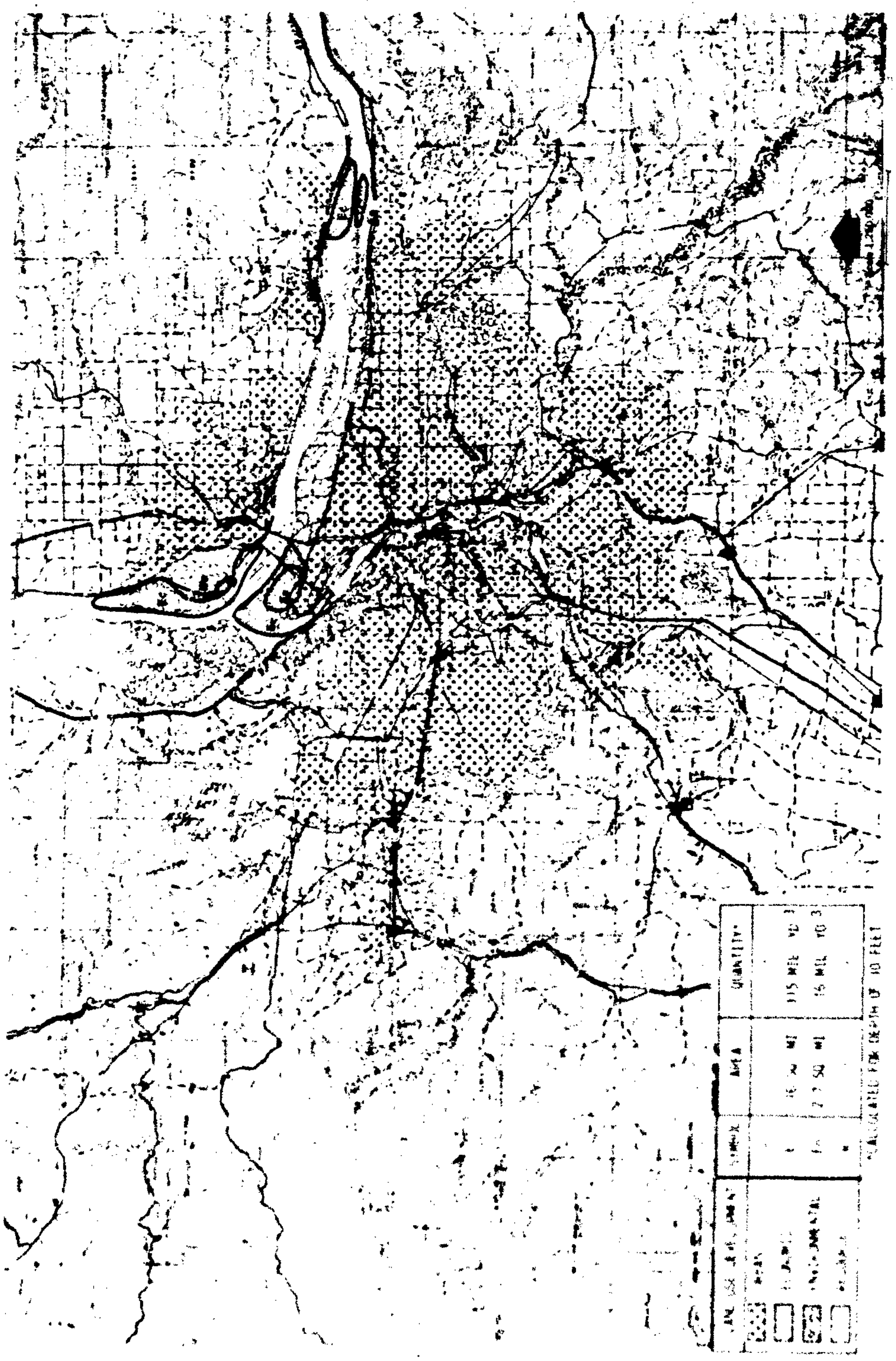

Fig 6.12 Generalized Regional Development Plan
Portland Area

191. The most extensive proposal is that of the Rivergate Project in the North Portland Peninsula.[6.9] The North Portland peninsula proposals are for multiple use purposes integrating industrial development and open space recreation with residential and other urban services. Figure 6.13 illustrates the land area to be developed and an area presently used as a sanitary landfill project. The sanitary landfill is operated by the City utilizing dredged material as soil cover. Upon completion of the landfill operation the area is to be used for future recreational purposed by the City Parks Department. The total project will cover approximately 5000 acres of which about 30% has already been filled. It is estimated than another 20 million cubic yards are still required to complete the project. These areas have been filled hydraulically with Columbia River sand which has excellent foundation qualities. Eastern portions of the area are surrounded by dikes to create drainage districts and protection from annual flooding. Both the Columbia River and the Willamette Rivers have authorized 40 foot deep channels which have been dredged and are maintained by the Corps of Engineers. Probably the most beneficial use economy-wise is the increase in available land fronting on this deep water navigation channel. The amount of land presently fronting the channel is extremely limited but vitally important to the economy of the city.

192. The southernmost area designated En on Figure 6.12 is Ross Island. Ross Island is privately owned and being mined for sand and gravel. Much of the island has already been removed. The city of Portland and environmental groups are concerned that complete removal of the island will have detrimental effects to the loss of area wetlands. A present agreement with the island owners is that they must replace on the island an amount equal to that which has been removed by mining. This would provide a ready location for large quantities of dredged fill and also preserve the island.

193. The Pacific Coast Region was found to be knowledgeable about dredged material problems. Efforts are being exerted by public and private groups to convert the inherent problems of dredged material to practical solutions. Most public agencies are aware of dredgings as a potential landfill material. It is apparent that the mountainous terrain dividing the region is and will be a major factor in economically making use of dredgings

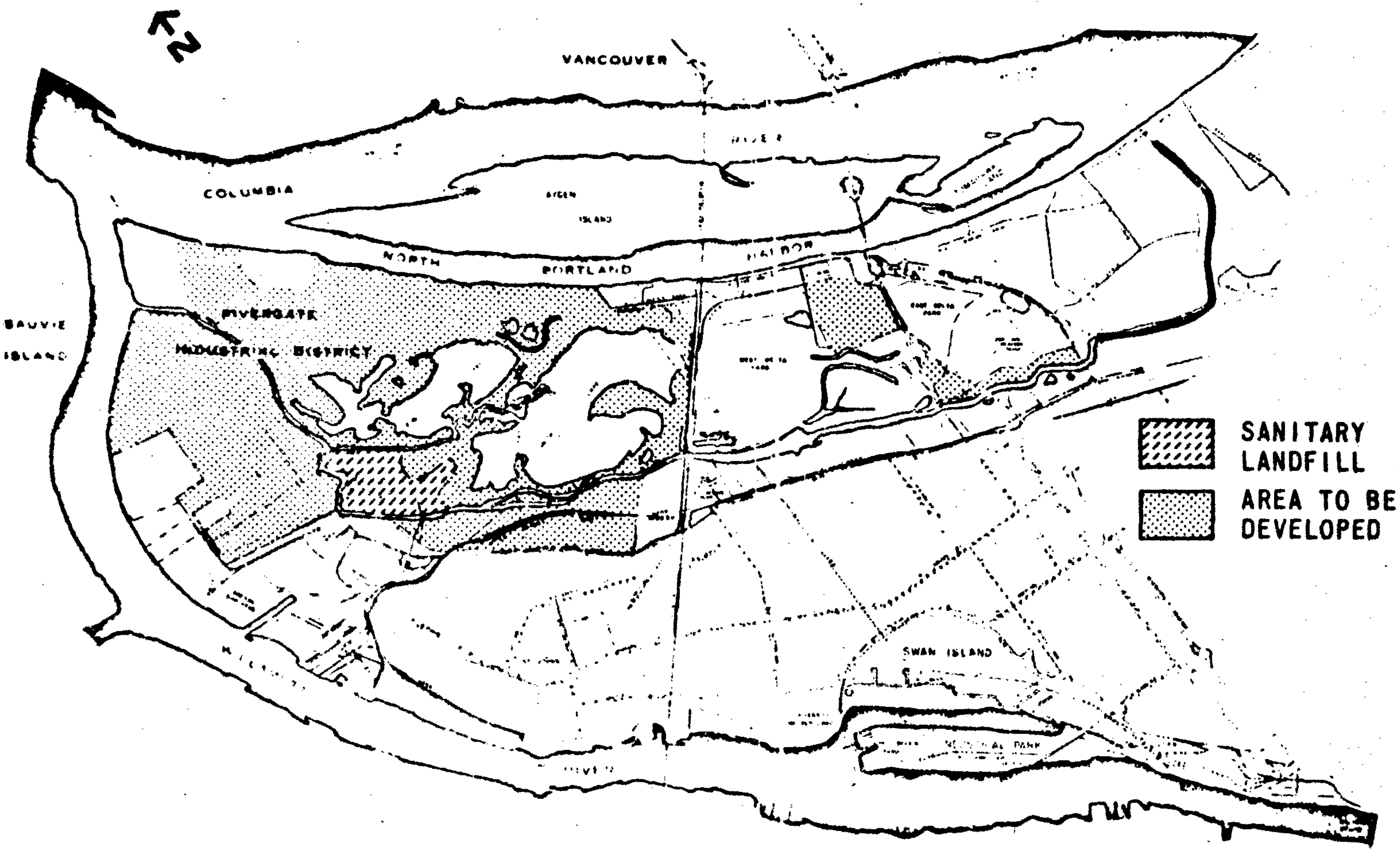

Fig.6.13 North Portland Peninsula Plan

feasible due, primarily to high transportation costs. Throughout the three state region, various groups and agencies have been and are continuing to work with the District Corps of Engineers to locate suitable diked disposal areas or to find practical ways of applying the material to land development or land preservation. Studies are in progress to make an inventory of all sources along the coastal area and to develop coastline management plans that will reflect practical applications and controls.

194. In some of the coastal areas of California, dredged material was not a satisfactory fill material because of its unstable qualities and inability to support structures. The EPA has stopped some landfill operations because the pollutants are draining from the spoil as it drys and contaminates the marine life, and the water from which it was dredged. The State University in Oregon is conducting research to ascertain ways in which dredgings can be used without contaminating the environment. Sand and gravel is being extracted for use in the concrete and construction industries. Dredged material is being combined with earth and other materials to construct dikes and levees for flood control. Solid waste landfills are being covered with dredged material. The Portland Airport complex has been extended by using dredged landfill. Port facilities have been expanded and newly developed in certain estuarine and coastal areas. Marshlands have been filled for PUD development, but the EPA and new state laws are limiting these practices because of the negative effect on the shoreline and estuarine ecology. State owned marshlands have been preserved as bird and wildlife feeding areas and habitats with the use of dredged material. Road embankments have been constructed from dredgings when they have been readily available. In certain agricultural areas, dredged material is mixed with the soil to improve the fertility and composition. In other areas, material is stockpiled for use by anyone who has a need, however, the availability of the material is not widely advertised. Most of the groups contacted expressed a need to know the composition and physical, chemical and hydraulic characteristics of the material to which they will have access.

PART 7. AVAILABILITY AND UTILIZATION OF DREDGING AS CONSTRUCTION MATERIAL

Present Availability of Construction Material

General.

195. Although construction is generally visualized as primarily an activity involving large labor and equipment resources, the relative use of materials by the construction industry far exceeds its share in the gross national product.[7.2.] In weight and volume, more materials have to be mined, quarried, and transported to build and maintain homes, roads, schools, bridges, pipelines, dams, etc., than are required in any other type of activity. It is not difficult to foresee an increased demand for construction materials in the years ahead as our metropolitan areas expand and that very expansion absorbs many present sources of supply for construction materials. When this situation develops, it will be necessary to import a portion of our needs or to draw them from another section, such as our dredged material resource.

Sand and gravel resources.

196. Production. The almost insatiable demand for sand and gravel for concrete over the past 40 years has led to heavy demands on existing resources near large population centers, with serious shortages developing. The problem is most acute where nearby available reserves are rapidly becoming depleted, and where land-use conflicts and amenity costs impose as additional hardship on these operations. The increasing demand, fueled by growth in population and rapidly expanding urbanization is illustrated by Figure 7.1, which indicates a 1970 usage of almost 4.6 tons per capita and increasing at approximately two thirds of a ton per capita for the succeeding decade. Careful study of production data, indicates significant regional per capita usage differences with the national usage figures serving merely to indicate trends in sand and gravel consumption over the past half century. Based on the 1970 production figures, which are the most recent available, the regional consumption has been tabulated and is presented in Table 7.1.

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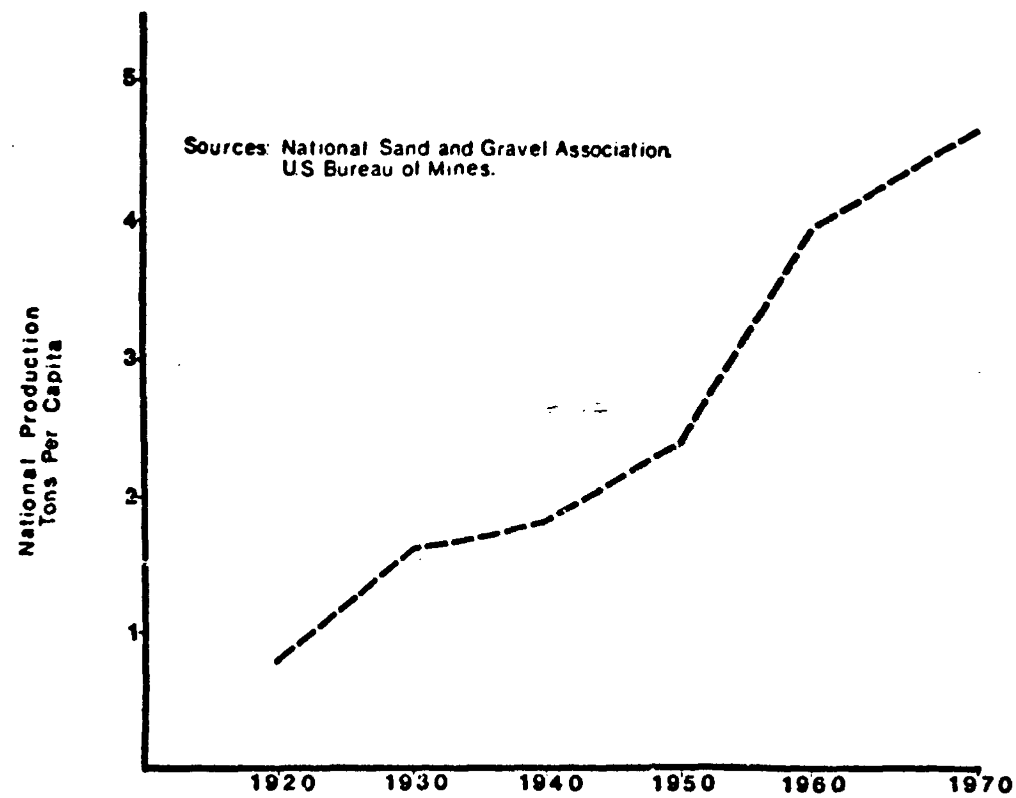


Fig. 7.1 Per Capita Sand and Gravel Production

197. Sand and gravel operators all over the country have in recent years begun to feel the pressures, like many other industries, of the trend toward environmental protection. Large populations moving from cities into suburban areas have pre-empted by development much land intended for future production of sand and gravel resources. The presence of these people in the suburban areas near operational centers has increased the pressures to restrict operations. Frequent objections include the hazards of truck traffic, noise and dust, and the unsightly nature of the excavations. Great pressure is exerted by local authorities, particularly in west coast states, to force reclamation of surface pits and quarries by the operators. In every area contacted, operators expressed an interest in reclaiming pits with dredged material in instances where transportation and enviornmental problems can be solved. All of the pressures mentioned above combine to produce an atmosphere conducive to the use of the dredged material found suitable or material that can be economically processed into a usable state. In times past, it was always feasible to find other sources of sand and gravel, still within easy and economical hauling distance, to replace an exhausted or pre-empted site. In many large urban areas it is becoming increasingly evident that the more easily accesible deposits have been depleted, zoned out of existence, or swallowed by urban expansion.

198. Dredged material is being used on a small scale as a sand and gravel resource in a few areas of the country. On Long Island, some dredged material is being sold as sand and gravel, but the amounts are small and result as a by-product of dredging activities for other purposes. [7.3.] The long-range prognosis for the North Atlantic Region is one of rapidly increasing demand and decreasing availability of enviornmentally acceptable inland sources within economic hauling range. Large quantities of high grade aggregates are being extracted from underwater deposits in western Lake Erie and along the Lake Erie and Lake Ontario shorelines. These underwater sources are expected to be utilized more as upland sourced diminish. [7.11.] Similar small scale utilization is being made of Corps dredgings in the

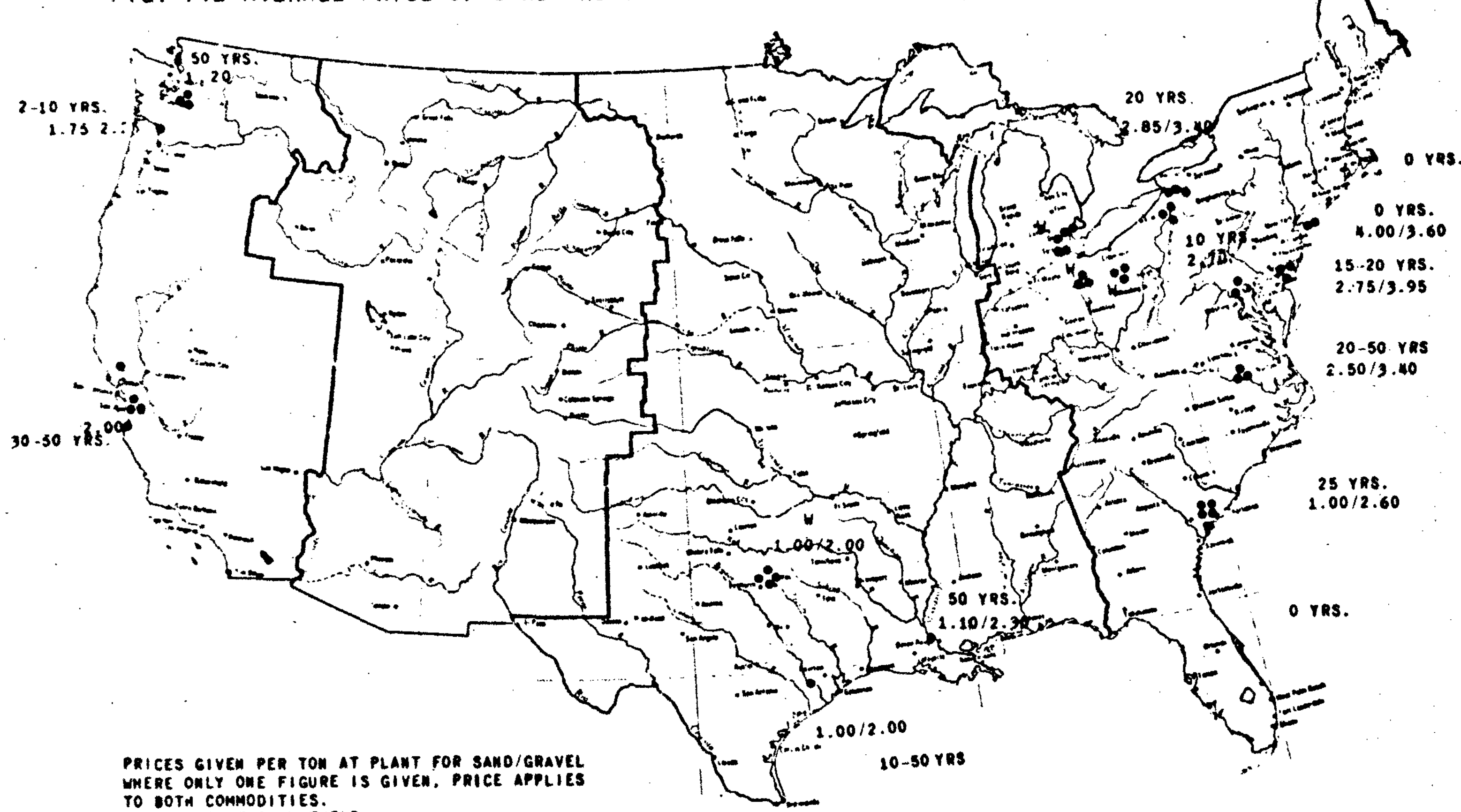
upper portions of the James River in Virginia and from dredgings of the Willamette River Channel in Portland, Oregon. It is interesting to note that these commercial utilizations occurred in fresh water deposits containing significant gravel fractions.

199. During the course of this investigation, many aggregate producers associations and individual producers were contacted to ascertain the status of present sand and gravel operations in the various study regions. From information supplied by these sources, Figure 7.2 has been prepared to indicate a broad national overview of life expectancy of existing resources and the approximate range of costs as indicated by national indexes. The per capita regional usage and the life expectancy of existing reserves indicate that severe deficiencies of nearby resource presently exist in the northeast population centers of Boston, New York, and Philadelphia and in the heavily urbanized east coast areas of Florida, principally Jacksonville, and Miami.

Regional evaluation.

200. The Regional demand for sand and gravel in the North Atlantic area is 2.1 tons per capita as indicated in Table 7.1. Based on this figure, local deficiencies existed in 1970 in the states of New York and Pennsylvania. These deficiciences were met by corresponding over-productions in New Jersey and Delaware respectively. The over-productions shown for Maryland and Virginia represent the material used in Washington, D.C., which produces no sand and gravel. The conclusion therefore is that a need exists for a local source of supply at the major population centers of the two deficient states, which are the cities of New York and Philadelphia, as well as in Boston. Current demand in these deficient areas is being serviced by sources as much as 70 miles away with the bulk of the materials being delivered by trains and barge. Because of the long haul distances and questionable long term reserves, considerable interest in these areas is centered on developing a viable offshore production of sand and gravel. The Department of the Interior is presently developing plans to hold offshore mineral lease sales to alleviate these shortages. Producers in the Baltimore and Washington areas are preparing long range plans to

FIG. 7.2 AVERAGE PRICE OF SAND AND GRAVEL AND LIFE EXPECTANCY OF PRESENT SOURCES



PRICES GIVEN PER TON AT PLANT FOR SAND/GRAVEL
WHERE ONLY ONE FIGURE IS GIVEN, PRICE APPLIES
TO BOTH COMMODITIES.
W - INFORMATION WITHELD
LIFE EXPECTANCY OF SOURCE GIVEN IN YEARS

barge sand resources from North Carolina, a distance of over 100 miles as soon as their upland resources are depleted, and continue to supply their gravel needs by additional extensive quarrying of rock.

201. South Atlantic. The Regional demand for the South Atlantic Region is 1.7 tons per capita. Local deficiencies therefore exist in the states of Florida and Georgia which are currently being met by over-productions in adjacent states. The most severe shortages appear in the populous and rapidly expanding east coast of Florida and especially in the Jacksonville areas where it has been reported that significant quantities of sand has been barged from South Carolina producers.

202. Gulf States Region. The Gulf States portion of Florida as well as Alabama show local deficiencies based on the Regional demand figure of 2.5 tons per capita. These deficiencies are currently met by surplus production from Mississippi and Louisiana. The most critical shortage in this region appears to be of large aggregate of the 1 to 1½ inch size as local physiography precludes development of crushed rock to supply this demand.

203. Great Lakes Region. The western portions of New York and Pennsylvania also show local deficiencies which are met by outside sources. The state of Ohio shows self-sufficiency and Michigan shows a great over-production which is exported to other areas.

204. Pacific Coast Region. Demand in the Pacific Coast Region, 7.2 tons per capita, far exceeds the national average of 4.6 tons per capita. Each of the three states in the Region produced sufficient sand and gravel in 1970, for its regional needs. However, the San Francisco area with a per capita production of 4.8 tons is far below the region's average consumption of 7.2 tons/capita and California's state wide average consumption of 7.0 tons/capita

Availability of Dredged Material as a Construction Aggregate.

205. Most material dredged by the Corps of Engineers in maintenance projects near major population centers throughout the study regions appears unsuitable for use in the sand and gravel industries. Some material is generated, however, that could be used as

aggregate. This material consists of sand, gravel and shell. The volume of suitable materials from maintenance dredging is often extremely difficult to ascertain since the Corps Districts have not kept detailed inventories. The best estimate at this time outlined in Technical Report H-72-8, 1972 is shown on Table 7.2 with a corresponding estimated per capita usage for the region, assuming full utilization of this resource. Additional volumes could be obtained at selected locations from certain new work projects and other dredged material which includes various mixtures of sand and silt requiring expensive separation processes to make them suitable for use in the sand and gravel industry. Conversations with representatives of the National Sand and Gravel Association and several large sand and gravel firms indicate that before sand and gravel operators will avail themselves of dredged material resources, at least a ten year supply of material must be guaranteed. Extensive rehandling facilities will also be required to expedite use of dredged material as aggregate. Sand and gravel interests probably could not bear the costs of such facilities. A possible method operation is to deposit suitable material in a confined disposal area which would serve as a base of operations and stockpile for future use of the material as aggregate. Materials encountered in new work projects, which in many cases is likely to be more suitable for aggregate use than maintenance material, could also be deposited in the confined disposal area when this material is available.

206. Another problem associated with use of dredged material as aggregate is the proportions in which the material constituents occur. A normal concrete mix requires two parts gravel to one of sand. This mixture is achieved in upland sources by mining gravel and obtaining the sand as a by product of the gravel washing operation. Where suitable dredged material is encountered, the reverse situation is normally true - i.e., the dredgings are predominantly sand with the gravel occurring as the by-product. In this respect, dredged material is of a lesser value to aggregate consumers than is material from an upland source, except in areas where gravel resources are depleted and are being presently supplied by quarrying and crushing rock. From the developed usage data it is apparent that substantial benefits could be obtained by selected development of dredged material as a sand and

gravel resource in areas found severely deficient. It must be borne in mind however, that the location of dredging projects containing such resources may often not be within an economical distance at the present time. Further, the great majority of these projects contain an abundance of sand resources of which there is a greater supply than gravel. The area of the nation where the greatest potential exists for commercial use of dredged material is in the Portland area of Oregon. In the past the Willamette and Columbia Rivers has been a constantly replenishing source of sand and gravel. Lately, however, the construction of dams upstream has curtailed the drift of particles downstream, resulting in a trend toward rapid depletion of the accessible deposits. The metropolitan Planning Council of Portland Oregon predicts that these river deposits could well be exhausted by 1980 [7.5] and some individual operators give life expectancy estimates of as low as two years. Sources contacted in this region expressed the greatest interest in using dredged material if the material is found to be suitable. The apparent significant volumes of sand and gravel being dredged by the Corps in this area could substantially alleviate the anticipated deficits of these resources if they would be made available.

Engineering Characteristics of Dredged Material.

207. In order to establish a correlation between dredged material availability and an established need for construction materials, an understanding of the pertinent characteristics of dredged material is necessary. From an engineering and material characteristics standpoint, dredged material falls into the categories of fine grained, coarse grained, or a mixture of the two. The engineering characteristics of dredged material depend upon a number of basically independent, external variables. The qualitative relationship between these variables and the engineering properties are shown schematically in Figures 7.3 and 7.4 and the parameters involved in this relationship are discussed below.

208. Engineering characteristics of dredged material are considerably influenced by the geographic location of the source of dredging. If the dredging site is located in a littoral zone, it is likely that the material will be predominantly coarse-grained. On the other hand, material taken from estuarine zones is more likely to consist of fine-grained sediments. Materials encountered in routine maintenance dredging are usually quite

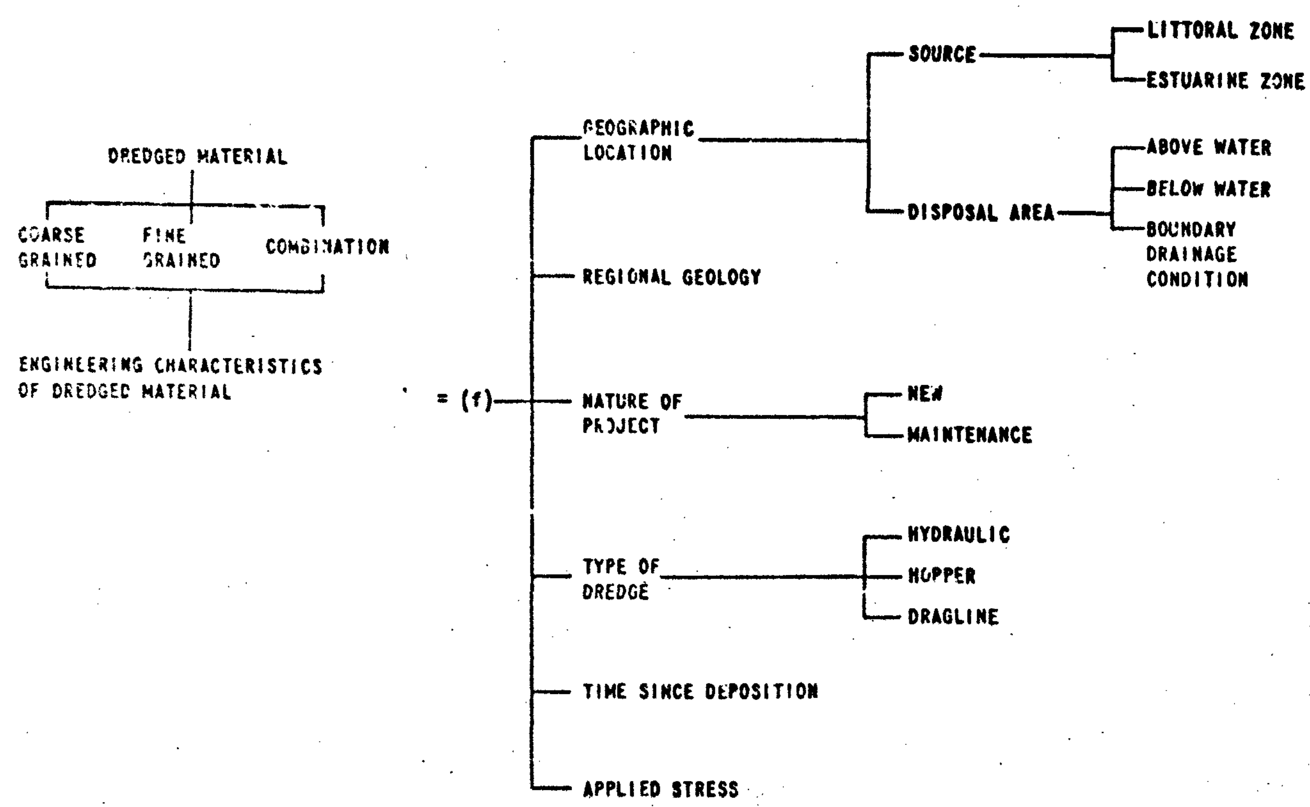


FIG.7.3 SUMMARY OF ENGINEERING CHARACTERISTICS OF DREDGED MATERIAL

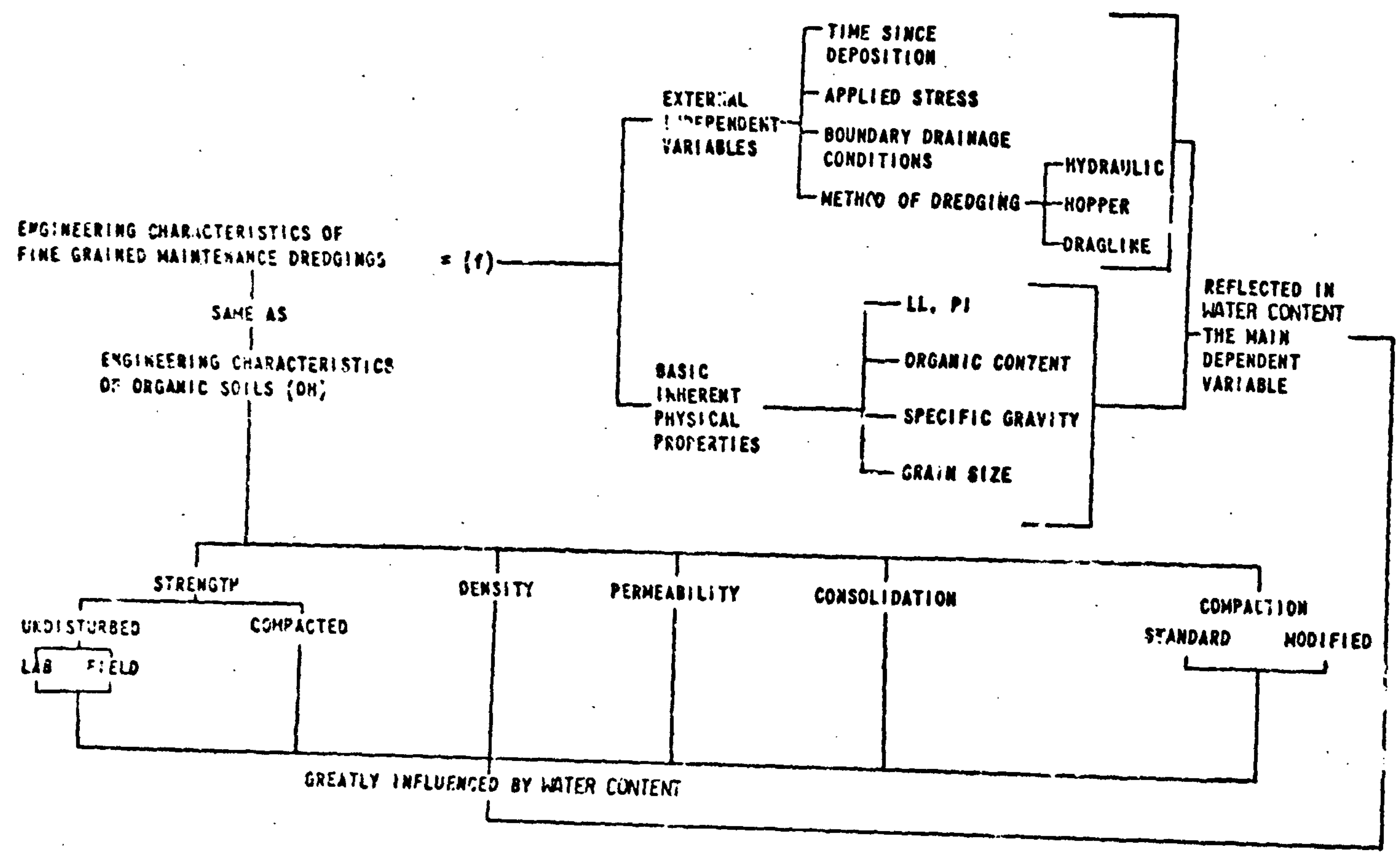


FIG. 7. SUMMARY OF ENGINEERING CHARACTERISTICS OF DREDGED MATERIAL

different from those dredged in new work projects such as channel deepening, widening and straightening, or in the opening of new channels. In some cases maintenance material is finer-grained and not aggregated into clumps, while new work dredgings frequently tend to be more coarse-grained and are more likely to consist of lumps of material. Coarse-grained material is usually sand with some occasional gravel encountered.

209. Through the nation, dredging is accomplished using varied types of equipment including hydraulic pipeline dredges, hopper dredges, and bucket or dragline dredges. These diverse methods result in material of different consistencies and engineering properties. Materials deposited with a hydraulic pipeline dredge will be segregated with respect to particle size. This is due to the fact that the material is pumped in a water suspension state causing the fine particles to remain in the slurry water much longer than the coarse particles. Materials removed with a basket or dragline will be deposited in approximately the same composition that they possessed originally.

210. In the case of fine-grained materials, engineering properties depend upon the degree of consolidation, a function of applied stress and the duration of that applied stress. Very little data is available on the engineering characteristics of coarse-grained dredgings. This situation is undoubtedly due to the fact that engineering problems associated with dredged coarse-grained materials are minimal in comparison to those problems encountered with fine-grained dredged material. Hence, the engineering properties of fine-grained maintenance dredgings are paramount to the understanding and behavior of dredged material as construction material. Engineering properties of fine-grained maintenance dredgings may be expressed as functions of two independent groups of characteristics. The first group includes such parameters as time since deposition, applied stress, boundary drainage conditions, and method of dredging. The second group of important characteristics include Atterberg limits, organic content, specific gravity and grain size distribution. The combined effects of these various parameters are qualitatively reflected in one main physical property-*water content,* which governs the engineering characteristics and various independent and dependent variables are shown schematically in Figure 7.4.

211. In order for dredged material to be technically acceptable as construction material, the water content must be greatly reduced. Dewatering can be accomplished in various ways, e.g. placing material in thin lifts and allowing it to dry, placing material on high ground, improving internal and boundary drainage by installing ditches and sand drains, electro-osmosis, or a combination of the above measures. A more detailed discussion of these methods is not included in this report, since methods of dewatering to improve engineering properties are outside the scope of this investigation.

212. Results of preliminary experimental studies indicate that some dredged material can be utilized in the manufacture of brick, light weight aggregate and related ceramic products by the sintering process. On the basis of these favorable results, it will be necessary for further studies to substantiate the economic feasibility of such operations. This study must include plant production capabilities as well as a full scale production cost and market analysis to determine whether products made from dredged material can be produced and sold at a competitive price. Experiments in producing brick from sintered dredged material from Charleston and Georgetown Harbors are still in progress at Clemson University, under sponsorship of the Charleston District. Although the report on these activities is not yet available, personel conversations with Dr. G.C. Robinson of the Ceramic Engineering Department at Clemson indicate a high degree of success. Another experiment in brick making done by the Franklin Institute under Philadelphia District sponsorship was less successful. Dredged material samples sent to a local brickmaker could not be made into a usable brick using the usual process. The difficulty arose from the fineness of the material necessitating the addition of uneconomical amounts of binding agents. The adaptability of dredged material to a manufacturing process varies with the nature of the material found in the region.

PART 8. LANDFILL PLANNING, USE AND CONSTRUCTION METHODOLOGIES.

213. Landfill and construction material needs have been demonstrated in every region studied. Inventories of projected landfills contained in this report, as well as a review of proposed projects, indicate that low-lying areas have the greatest need for landfill where economic growth is projected for the region. Most dredging activities are associated with a port and its approach improvements. The area of greatest dredging activity is the Gulf States Region where practically one-third of the nation's annual dredging is being accomplished. In areas where dredged material has more desirable characteristics (coarse grained material), as in new work in the Great Lakes and Pacific Regions easier solutions have been found for economic disposition of this dredged material. Maintenance dredging, fine particle material, organic and contaminated dredged material disposal may create additional costs in utilizing material due to their quality and high water content. In conversations with many planners responsible for developing land use plans, it became evident that dredged material is often associated with undesirable characteristics. It appears that substantial work needs to be accomplished to promote all understanding of the behavior of dredged material from enviornmental and physical aspects. Understanding of problems and costs associated with making landfill uses attractive for planned purposes without enviornmental degradation, and providing for environmental mitigation where planned overall benefits exceed previous land use values will require a multi-discilinary team approach. Many fears presently expressed by environmentalists and affected residents sometimes are not based on fact, due to a lack of knowledge of physical, chemical and biological interaction of dredged material with its environs.

214. Substantial environmental benefits, as well as socio-economic benefits, have been accrued from utilizing dredged landfill sites which originally were planned purely as disposal sites. Some of these projects created shrimp nurseries, biologically valuable marshland and wildlife refuges. Some of these landfills are now protected against additional

dumping because of their high ecological value and contribution to the environmental and recreation values and economy of the region. The planning of land development will require detailed evaluation of the commercial and socio-economic benefits to the enviornment. Ultimate land use established for regions, based on projections of population and economic growth, must be balanced with desired quality of life, to include opportunities for economic growth as well as cultural and recreational institutions. Economic growth is an absolute necessity to provide the capital funds necessary to sustain continuous improvements of water and air quality. Other public services as well as open space, parks and recreational opportunities depend upon capital funds obtained by increases in a region's economic growth.

PART 9. NEW CONSTRUCTION TECHNOLOGY NEED WITH DREDGED MATERIAL.

215. The draft of the technical report of "Practices and Problems in the Confinement of Dredged Materials in Corps of Engineers Projects," by W.L. Murphy and T.W. Zeigler, published in August 1973, described the sta us of confined dredged material disposal, containment area design and operation, retaining dike design, construction, and stability as they have evolved and are being carried out in various District operations. Many districts are sponsoring research projects and performing planning to determine alternatives of utilization of dredged material. The Charleston District sponsored the study by Clemson University of the feasibility of producing ceramic products from dredged materials from Charleston and Georgetown Harbors. The Philadelphia District sponsored the study, "Building Materials from Dredged Spoil," 1971, prepared by the Franklin Institute Research Laboratory. A study by Yale University, Department of Geology and Geophysics has also been accomplished for "Conversion of Dredged Spoil to Light Weight Construction Aggregate". Marketability potential and the cost of products have not yet been established; however, additional studies and experiments are in progress. Some of these failed, e.g. the Certain-Teed Products Corporation, Valley Forge, Pa. attempt to produce marketable products. Other projects such as the Yale and Clemson University work still hold promise for the development of dredged material as sintered construction products and/or aggregate.

216. Hittman Associates, Columbia, Maryland, is preparing two studies; one for EPA and one for ODMR for dredged material separation drying and rehandling. The capability to dewater dredged material without creation of effluent quality problems will go a long way toward aleviating dredged material disposal problems and will specifically increase the use of a valuable resource. Long strides are being made in effluent control and in planning and design of containment areas by developing concepts for natural control and filtering capabilities under the WES dredged material research program.

217. The other areas of great concern are the providing of capabilities for quickest consolidation of placed dredged material to enable one to start planned land use of landfill area as soon as practicable. Techniques are being perfected presently to utilize, in lieu of sand or gravel piles, paper piles to facilitate extraction of water and thereby consolidate the fill material in a shorter time period. Depending on the costs, land values and needs, some of the feasible systems may be too expensive to justify artificial consolidation.

218. There exists a dire need for development of a new construction technology and more practical modes of transportation for dredged material to enhance its use in construction. Currently dredged material is transported from the source of dredging to the containment area by barges, trucks, trains or pipelines. Economic and environmental considerations greatly limit application of these methods in many areas. With current knowledge, it is technologically feasible to pump dredged material 70 to 100 miles, although this practice is not always economically feasible in areas where the terrain requires many booster stations. Conversations with representatives of IHC Holland Dredger Division indicate that many pipelining operations have proved economically justifiable at the 10 to 15 mile range. Perhaps the greatest need for new technology is in the methodology of placement and improvement of engineering properties of dredged material.

219. Another prominent problem, as discussed in Part 8, is to obtain land areas of sufficient size where economical and timely creation of landfills can be accomplished. This problem will apply not only for landfill creation for environmental or commercial uses, but also when applicable, for resource stockpiling of material for reclamation. An example project NOMES, planned for exploiting offshore aggregate mining to determine its feasibility from an ecological standpoint. The New England Mining Offshore Study was organized to last approximately four years with appropriations of $5 million, sponsored by the Commonwealth of Massachusetts and the National Oceanic and Atmospheric Administration (NOAA), six other Federal agencies including the Corps of Engineers, two Massachusetts State Agencies, nine universities and institutes, and three industries. The

project was scheduled to start in June 1973 and was to involve the removal by suction hopper dredge of 1,000,000 cubic yards of sand and gravel from a site in Massachusetts Bay located 12 miles east of Logan Airport. This project has been postponed until a site is found for dredged material stockpiling in the Boston Harbor area.

PART 10. CONCLUSIONS

The assessment of landfill and construction material needs by regional division along the coastal areas of the nation has revealed that a need for such material does exist. However, the consideration to use dredged material for landfill purposes is met with resistance. Immediate reaction is to question quality, cost and transportation as conditions to be evaluated prior to acceptance. General knowledge of dredged material availability declines with increased distance from the source of dredging operations. There appears to be a general lack of awareness that such material could potentially be made available even by agencies near the source of dredging. Most agencies expressed an interest in using dredged material as landfill if it were made readily and economically available. A variety of uses are made on areas filled with dredged material ranging from port facilities on the coast to urban developments and highway construction inland. Although no unusual or unique use of dredged material has been found, experimentation with the material is being done. There are a number of example efforts to enhance agricultural soils, cultivate marsh grasses and use dredged material as a sanitary landfill cover - all of which express a range of interest in developing beneficial use of an apparent waste material. Most successful use applications have been in expanding urban land areas adjacent to the coast. Industrial parks, airports, commercial centers, residential subdivisions, recreational parks as well as wildlife sanctuaries have been built on land created by dredged material deposits. Such developments have benefited their areas economically and environmentally. However, continued use of dredged material for such land creation has been severely criticized by environmental groups who have urged curtailment of these developments in most places. While there is a real need to protect our natural environment and concerns over the unwarranted destruction of irreplaceable habitats are appropriately taken, there also is a definite responsibility to accommodate valid growth needs. In our present time, it will become increasingly necessary for cooperative planning to see that growth is accommodated without destroying our basic resources. Most regional planning agencies have respected environmental concerns along

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coastal marshes and wetlands in their planning and land use policies by restricting development in these areas. However, in certain situations where land development is concentrated and space limited, land uses on swamps and low lying areas appear as plan recommendations in order to accommodate inevitable projected growth. Growth is a function on man's environment as well, and also is a contributing convenience of life; it cannot be ignored. Therefore, planning decisions affecting land use issues are also decisions affecting the environment. A review of typical regional comprehensive plans shows that a great quantity of landfill material will be needed in order to realize the recommended land use pattern and to respect the general goals of preserving the health, safety and welfare of the people. This investigation indicates that a key to finding workable solutions to the disposition problems asssociated with dredging material and locating environmental and/or economic uses lies with local and regional planning agencies. A balance between accommodating man's needs as well as nature's needs can be achieved with coordinated efforts between the Corps District offices and planning agencies. Coordinated policies in each district area should be developed for both public and private benefit.

PART 11. RECOMMENDATIONS

In the most simple terms there are two practical areas for the disposition of dredged material, a) in open water and b) on land. The purpose of this study was to assess the practicalities of disposal on land. The conclusions reached are strongly for a practical scheme to deposit dredged material where the greatest advantage can be made of it as a resource rather than as a waste product. One practical scheme to make dredged material generally available is to store it at strategically located stockpiles. Stockpiles could be located in a similar manner to that used in locating storage-transfer stations for solid wastes prior to transporting to landfill sites. This scheme could make material stockpiles available to areas in proportion to their population and density patterns. Once stockpiled, any use application needing unspecified fill material can be accomplished. A procedure would be necessary to initiate an operable stockpile program which would require the depositing of material into confined diked areas permitting excess water to drain. The effluent can be channeled into retention ponds, sewage lagoons or other treatment processes prior to being returned. At this point, if necessary, the material could be cleansed and dewatered. Transportation would be necessary to deliver the material to the stockpile site. Costs involved in this program could be defrayed by imposing minimal costs per cubic yard delivered or by absorbing the entire expense as the cost necessary to maintain environmental quality. From the stockpile locations the material could be used in land developments or construction projects. A priority basis could be established whereby governmental and municipal agencies would have first pick. Secondary priority could be for uses engaged to improve or increase economic activity; thereafter any private demand for material usage could be permitted.

Another recommended use of dredged material is in the creation of new land either by extending the shore line further into water bodies or by creating artificial islands. Since the materials dredged in harbors and waterways cannot be easily transported and dewatering

processes are generally slow, it is a practical consideration to create new land masses in the vicinity of the dredging operation. While there may be some environmentalist resistance to this practice, its practicality over the long term could prove to be beneficial. Such improved land or newly created land can be sold (if legally feasible) as a means to defray the costs incurred. There two methods can be successful provided that both environmental groups and Corps personnel coordinate their policies in an organized program of long-range planning in conjunction with the loc established and official governmental planning agencies.

Key points to be considered by Corps Districts are as follows:

a. To the greatest extent possible, dredged material disposal sites should be selected with a view to their incremental incorporation into comprehensive regional and local p or new land use development.

b. The assistance of regional planning and regulatory agencies should be enlisted to make a determination of priorities between the conservation and/or preservation of wetlands vis-a-vis the growth requirements of all sectors of the economy.

c. Marshlands should be examined and rated in terms of their true ecological value, and those of lesser value considered for acquisition as disposal sites

d. Stockpile locations should be convenient and materials made readily available with the minimum of requirements.

e. Long-range planning and coordinated land use policy should be established within each Corps District in cooperation with local planning agencies.

Comments made by a member of the Sierra Club as reported in an issue of the Urban Land Institute's publication *Urban Land* are presented here as an appropriate

conclusion. "The real challenge will be to accommodate legitimate growth without destroying the environment in the process". The challenges and responsibilities of land use planning in the future will be in:

a. Educating people about the limitations and finite capability of the land to absorb further growth

b. Restructuring laws and institutions.

c. Maturing in our attitudes and responses to growth and situations of stress by graduating from an era of chaotic, ad hoc, short-term, case-by-case, crisis-to-crisis decision making, to an era of long-range planning and management based on democratic processes and a full appreciation of all legitimate primate and public aspirations and needs. This process of maturation must take place not only in government, industry, and business, but within the environmental movement as well. Unless we work within a realistic and humanistic visions of the future, day-to-day crises will be of minimal long-term value. Too often in the past and even today we environmentalists have focused on America Yesterday or America Today, when the real challenge lies in seeking America Tommorrow."

TABLES

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TABLE 2.1
GENERAL ECONOMIC PROFILE: SELECTED DATA
GULF STATES

	TEXAS	LOUISIANA	MISSISSIPPI	ALABAMA	FLORIDA
1970 Employment					
% Manufacturing	18.5	15.9	25.9	28.6	14.1
% Wholesale & Retail	22.2	21.2	17.9	19.0	23.5
% Construction	7.7	8.3	7.5	6.9	8.5
% Government	15.5	17.2	18.0	17.3	16.0
1970 Unemployed	3.6	5.4	5.0	4.5	3.8
1967 Manufacturing					
Establishments	12,722	3,639	2,761	4,951	7,950
Value Added *	$10,922.4	$2,790.3	$1,635.3	$3,525.5	$3,688.7
1967 Retail Trade					
Establishments	110,805	30,597	20,543	28,752	58,727
Sales *	$16,448.6	$4,759.5	$2,523.6	$4,120.3	$10,280.3
1969 Agriculture					
Average Size Farm (Ac)	668	232	221	188	394
Value of Production *	$3,197.4	$475.4	$645.8	$634.8	$1,116.9
1967 Mineral Industries					
Establishments	6,123	1,382	307	294	210
Value of Production *	$6,527.4	$5,146.6	$230.9	$196.3	$336.7
1969 Median Fam. Income	$8,486	$7,527	$6,068	$7,263	$8,261

* Millions of Dollars

Source: U.S. Bureau of the Census, County and City Data Book, 1972.

TABLE 2.2
MATERIAL SUPPLY
GULF STATES REGION

USACE DISTRICT	MAINTENANCE	NEW WORK
Galveston	48.0	98
New Orelans	60.8	60
Mobile	30.2	1
TOTAL	139.0	159

* Quantity figures in millions of cubic yards/year.

Source: Boyd, MB. et al., H-72-8, November 1972, USAEWES, CE, Vicksburg, Mississippi

TABLE 2.3
SOURCE OF MATERIAL
GULF STATES REGION

SOURCE	GALVESTON	NEW ORLEANS	MOBILE	TOTAL
Outer Bar, Entrance Channel	9.5 *	22.3	3.7	35.5
Bay Channel	9.9		14.9	32.8
River Channel	3.1	10.2	4.1	17.4
Harbor	13.1	0.3	3.2	16.6
Intercoastal Waterway	12.4	20.0	4.3	36.7
TOTAL	48.0	60.8	30.2	139.0

* Quantity figures in million cubic yards/year.

Source: Boyd, M.B. et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 2.4
QUALITY OF MATERIAL
GULF STATES REGION

MATERIAL	GALVESTON	NEW ORLEANS	MOBILE	TOTAL
Mud, Clay, Silt, Topsoil, Shale	6.7 *	26.3	18.6	51.6
Silt and Sand Mixture	40.5	34.5	5.7	80.7
Sand, Gravel, Shell	0.7	—	5.9	6.6
Organic Muck, Sludge, Peat Municipal - Industrial Wastes	—	—	—	—
Mixed	—	—	—	—

* Quantity figures in million cubic yards/year.

Source: Boyd, M.B. et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 2.5*

GALVESTON, TEXAS

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Land fill for housing construction on Galveston Island. (1,3) 2. Educational Institution Moody College of Marine Science located on Pelican Island (3,2) 3. Resort expansion and pier extension in the Gulf of Mexico. (3)	1. Beach nourishment Galveston Island. (2) 2. Fish and Wildlife habitat established by dredged land fills in open water. (1,2) 3. Seawolf Park on Pelican Island. (3) 4. Flood plain management. (1,2)	1. Port facilities at Galveston and Pelican Island (2) 2. Jacintoport Industrial Park - 4500 acre development of which 500 acres were created by land fill. (3,1) 3. Industrial Development along the Houston ship channel. (1,2,3) 4. Highway construction - embankment material - Texas Dept. of Highways (2,4)	1. Support facilities for cattle spoil mounds along coast provide refuge in marsh land grazing area. (2)
PROPOSED	None Reported.	1. Recreational Area in Port Arthur - Lake Sabine. (2)	1. Superport facility. (5)	None Reported.
POTENTIAL	1. Establish land base on low-lying lands for urban housing. (1,4) 2. Parking lots. (4,3)	1. Recreational Development - Galveston Area - Golf Courses. (4,3) 2. Levee construction. (2) 3. Sanitary landfill cover material. (3,4) 4. Borrow pit fill. (1) 5. Marshland Mgmt: Stimulate marine nurseries. (1) 6. Grass land establishment in marsh areas 7. Flood Plain Management (4)	1. Industrial land use (4) 2. Highway construction - embankments, fill. (4)	1. Fill in areas to curtail subsidance. (1,4) 2. Concrete mix. (4) 3. Create stockpiles for future uses. (4) 4. Create land (islands, mountains, etc.) (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 2.6*

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
MOBILE, ALABAMA — EXISTING	1. New urban development in South Alabama region (3) 2. Commercial Resort Activity on causeway in Mobile Bay. (3)	1. Beach nourishment. (1) 2. Oysterbed development. (1,4) 3. Battleship Park - Recreational Area. (1,3)	1. Port development - Port St. Joe, Florida - Port of Alabama. (2,3) 2. Industrial facilities located at the Alabama State Docks, Alabama Ship Yards, McDuffie Island. (2,3) 3. Coast Guard Station at Sand Island. (3) 4. Industrial Park development: Jacintoport, Mobile. (3) 5. Causeway Road in Mobile Bay.	1. Sand and Gravel extraction by Private Contractors. (2) 2. Artificial Island development: McDuffie Island, Little Sand Island. (2,3)
PROPOSED	1. Housing areas proposed along causeway in Mobile Bay. (2,3)	1. Recreational Development on expanded causeway in Mobile Bay. (3)	1. "Ameraport" - new superport in Bay. (5,3,4) 2. Industrial expansion (3,4)	1. Sand expansion on Blakeley and Pinto Islands. (2,3)
POTENTIAL	1. Resort Development. (3)	1. Sanitary Landfill cover. (1,3) 2. Recreational Development. (1,2,3) 3. Expand Beach nourishment programs. (2,3,4) 4. Oyster Reefs. (4) 5. Flood Control. (4)	1. Highway embankments. (4) 2. Construction fill. (1) 3. Industrial land base. (4)	1. Develop sand and gravel resource. (1,3) 2. Reclaim low lying land areas: elevate flood plains, marsh. (3) 3. Soil erosion control. (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

GULFPORT, MISSISSIPPI

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS
TABLE 2.7*

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Residential/Comm'l land area developments (1.4)	1. Levee & dike const'n. in coastal areas. (1,2) 2. Beach nourishment & recreational uses. (1,4) 3. Rookeries on artificial islands. (1,3,4)	1. Industrial land uses adjacent to the Mississippi River. (1,4) 2. Harbor facilities	1. Oyster shells used as resource in cement. (1) 2. Artificial islands. (1)
PROPOSED	1. Urban expansion along coastal areas. (1,3) 2. Commercial expansion. (1,3) 3. Resort Development in Gulfport area. (1,3)	1. Marshland Development (1,3) 2. Recreational Development. (1,2) 3. Beach Nourishment. (4)	1. Industrial land development. (1,4) 2. "Ameriport" off Pascagoula, Miss. (5)	1. Agricultural expansion (1,4) 2. Forestry. (1,4)
POTENTIAL	1. Urban development on reclaimed land. (1,2) 2. Remove poor quality soils & replace with dredged materials to improve quality and permeability for future use of individual septic tanks and drainage fields. (4)	1. Park development. 2. Remove contaminated lake bottoms and replace with dredged fill. (4) 3. Sanitary landfill cover (4) 4. Borrow pit fill. (4)	1. Fill for roads and highways. (1,4) 2. Embankment material for highway development. (1,4)	1. Need to stockpile material for future developments. (4) 2. Agricultural soil nourishment. (1,4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 2.8*

NEW ORLEANS, LOUISIANA

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Significant portions of the City of N.O. (2,3) 2. L.S.U. Campus - New Orleans at Lake Pontchartrain. (2,3)	1. Recreational Areas - Lake Calcasieu - Atchafalaya Basin. (1,2) 2. Levee construction - Lafayette, La., New Orleans Area. (1,4) 3. Levees & Dikes for flood control. (1,2,3) Protection from erosion. (1,3,4)	1. Port facilities at New Centroport, N.O. (1,2,3) 2. Industrial uses at Centroport (N.O.) (1,2,3) 3. Highway construction - Interstate 10 (Baton Rouge). (1,4) 4. Airport at Lake Pontchartrain (N.O.). (1,2) 5. Private roads in New Orleans Area. (1) 6. General embankment material for roads. (1,3)	1. Sand extracted from Mississippi River by Private Contractors and sold as a resource. (1,3) 2. Range land for cattle. (1,4) 3. Artificial Islands. (1,2) 4. Development of land resource. (1,3)
PROPOSED	1. New Town In Town, New Orleans - Total Urban Development (1,3,4) 2. Land area expansion in N.O. at Lake Pontchartrain (1,3,4) 3. Resort developments at Lake Ponchartrain and New Orleans. (3)	1. Sanitary landfill Site: City of N.O. (1,3) 2. Levee construction & extensions - New Orelans, Baton Rouge, Lafayette. (3) 3. Sanitary landfills - Baton Rouge. (1,4,3) 4. Recreational Complex & Marina at Lake Ponchartrain in E. Jefferson Parish. (2,3)	1. Industrial expansion at Centroport, N.O. (3) 2. Airport expansion in Lake Pontchartrain. (4,1) 3. Superport in N.O. Port area. (3,4,5) 4. Westport Industrial Park in Baton Rouge - 1,000 acres. (3) 5. Industrial expansion in E. Jefferson Parish. (3)	1. Material Stockpile for use to fill area. (3,4) 2. Land extensions marshland areas. (3)
POTENTIAL	1. Reclaim marshland for urban uses. (1,4) 2. Elevation of Flood Plain Areas for Urban Development needs. (1,3,4)	1. Sanitary Landfill - Baton Rouge, New Orleans, Lafayette, Lake Charles. (1,4) 2. Borrow Pit Fill. (1) 3. Levee construction, Flood protection. (4)	1. Port Facility Development (Alexandria, La.) (4) 2. Improve highway network to facilitate evacuation during Hurricanes. (1,2) 3. Industrial Needs. (1,4)	1. Possible use to mix dredged material with other wastes to create useful agricultural soils. (1,2)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

TABLE 3.1
GENERAL ECONOMIC PROFILE
SELECTED DATA
SOUTH ATLANTIC STATES

	N. CAROLINA	S. CAROLINA	GEORGIA	FLORIDA
1970 Employment				
% Manufacturing	35.5	36.2	27.2	14.1
% Wholesale & Retail	17.5	16.7	19.5	23.5
% Construction	6.7	7.4	6.8	8.5
% Government	13.2	14.7	16.2	16.0
1970 Unemployed %	3.4	3.8	3.2	3.8
1967 Manufacturing				
Establishments	8,266	3,465	6,796	7,950
Value Added *	$6,606.5	$3,030.3	$4,683.6	$3,682.7
1967 Retail Trade				
Establishments	45,447	23,502	38.992	58,727
Sales *	$6,648.3	$3,103.5	$6,174.6	$10,280.3
1969 Agriculture				
Ave. Size Farm (Ac)	107	177	234	394
Value of Production *	$1,144.1	$342.9	$1,012.4	$1,116.8
1967 Mineral Industries				
Establishments	161	59	159	210
Value of Production	$67.4	$32.6	$145.8	$336.7
1969 Median Family	$7,770	$7,620	$8.165	$8,261

* Millions of dollars.

Source: U.S. Bureau of Census, County and City Data Book, 1972

TABLE 3.2
MATERIAL SUPPLY
SOUTH ATLANTIC REGION

USACE DISTRICT	MAINTENANCE	NEW WORK
Wilmington	4.2 *	3.5
Charleston	8.8	0.1
Savannah	8.3	3.0
Jacksonville	4.1	25.2
TOTAL	25.4	31.8

* Quantity figures in millions of cubic yards/year.

Source: Boyd, M.B, et al, H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 3.3
SOURCE OF MATERIAL
SOUTH ATLANTIC REGION

Source	Wilmington	Charleston	Savannah	Jacksonville	Total
Outer Bar, Entrance Channel	0.8 *	1.9	1.4	1.5	5.6
Bay Channel	0.1	3.1	—	0.7	3.9
River Channel	0.1	—	0.1	—	0.2
Harbor	2.4	2.7	5.9	1.6	12.6
Intercoastal Waterway	0.8	1.1	0.9	0.3	3.1
TOTAL	4.2	8.8	8.3	4.1	25.4

* Quantity figures in millions of cubic yards/year.

Source: Boyd, M B., et al, H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 3.4
QUALITY OF MATERIAL
SOUTH ATLANTIC REGION

Material	Wilmington	Charleston	Savannah	Jacksonville	Total
Mud, Clay, Silt, Topsoil, Shale	0.1 *	1.9	5.0	0.1	7.1
Silt and Sand Mixtures	1.7	6.5	1.5	2.6	12.3
Sand, Gravel, Shell	2.4	0.4	1.8	1.1	5.7
Organic Muck, Peat, Wastes	----	----	----	----	----
Mixed	----	----	----	0.[illegible]	----
TOTAL	4.2	8.8	8.3	4.1	25.4

* Quantity figures in millions of cubic yards/year.

Source: Boyd, M.B., et al, H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 3.5*

JACKSONVILLE, FLORIDA

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Fort Lauderdale along Intracoastal Waterway-residential. (5) 2. Dredging & filling to create waterfront real estate-Dade County, Florida. (5)	1. Jacksonville Park Development. (2) 2. Beach nourishment at St. Lucie Inlet, BAL Harbor Beach, Del Ray Beach, Dade County, Fla. (2) 3. Jacksonville Sewage Treatment Plant. (2) 4. Landfill at Palm Beach; Cape Canaveral. (4) 5. Park at Blount Island. (2)	1. Miami Harbor Development. (2) 2. Jacksonville & Lee County Bulkhead Extension. (2) 3. Fort Lauderdale along Intracoastal Waterway Commercial. (5) 4. Portions of Port Everglades Harbor. (5) 5. Canaveral Lock (5)	1. Dredged material stockpiles being used by private interests. (5)
PROPOSED		1. Flood Control Projects Central & Southern Florida. (5) 2. Flood Control-Green Swamp Area. (5) 3. Beach nourishment Key West, Palm Beach, Duval County. (5) 4. Beach nourishment to increase loggerhead turtle beaches-St. Lucie. (5)	1. Canaveral Harbor Extension. (5) 2. Blount Island Development Plan. (5)	1. Hurricane protection levees - Hillsborough Bay, Biscayne Bay (5)
POTENTIAL		1. 45 acre tract adjacent to Jacksonville Zoo. (5) 2. Erosion Control. (5) 3. Dredged Rock placed in deep water for fish. (5) 4 Flood control fill required in Dade County. (5)	1. Off Shore Loading Facility. (5) 2. Mayport Carrier Basin-Port development. (5) 3. Fill Required for I-395 Blount Is. (5) 4. Fill required for road SR-105.	1. Stockpile Material for Roads. (5) 2. Hurricane Protection. (5) 3. Gravel & Rock for construction is sparse. (5) 4. Rock & gravel stockpiled. (5)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

SAVANNAH, GEORGIA

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 3.6*

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING		1. Beach nourishment & hurricane protection - Jekyll Island. (5)	1. Portions of Port of Brunswick Docks. 2. Portions of Savannah Harbor. (5) 3. Marine Facilities. (5)	1. Farming Purposes. (5)
PROPOSED		1. Beach nourishment. (5) 2. Build shoals for marina life. (5)	1. Creation of offshore island as transhipment terminal at Savannah. (5) 2. Utilization of existing dredged sites for industry. (5)	
POTENTIAL	1. Develop marginal lands thru flood control dikes & levees. (5)	1. Park Development. (5) 2. Fill land to be used for recreation or residential. (5)	1. Bulkheading & fill along City of Savannah. (5) 2. Savannah Superport - Industrial & Urban. (5)	1. Stockpile Material. (5) 2. Fill land used for agriculture. (5)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

CHARLESTON, SOUTH CAROLINA

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 3.7*

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING		1. Annadale Plantation Aquaculture Research. (2) 2. Wynah Bay Wetland construction. (2) 3. Disposal areas used as Wildlife areas. Intra Coastal-Harbor. (5) 4. Beach nourishment Hunting Island Creek. (5)	1. Pee Dee & Waccamaw Rivers dredged strictly for fill material. (2) 2. Areas of George Town Harbor-industrial. (5)	1. Material dredged as fill material. (5)
PROPOSED	1. Hog Island - develop motel, boatel, seaquarium, retail stores. (5)	1. Flood plain controls. (5) 2. Hog Island - develop camping, marina, beach. (5)	1. Belle Island Marina - bulkhead & filled 180,000 cu. yds. (2)	1. Pee Dee & Waccamaw Rivers dredged str. tly for material - 150,000 cu. yds. (2)
POTENTIAL		1. Beach nourishment at Folly Beach & Edisto Beach. (5) 2. Small scale filling of swamps at McClellanville. (5)		1. Sand for construction. (5)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

WILMINGTON, NORTH CAROLINA

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 3.8*

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Emerald Isle - residential. (2)	1. Wrightsville Beach-beach nourishment & hurricane protection. (5) 2. Beach nourishment at Fort Macon State Park, Carolina Beach. (5)	1. Portions of State Ports Terminal - Moore-head City Harbor. (5) 2. Portions of State Ports Terminal - Wilmington Harbor. (5)	1. Artificial Island. (5)
PROPOSED	1. Seashore Estates - bulk-head extension. (5) 2. Boat basin at Knott's Island. (5) 3. Develop bulkhead at Albermarle Sound at Elizabeth City. (2)	1. Beach nourishment - Cape Lookout. (5) 2. Hurricane protection - North River Dike, Topsail Beach, Surf City, Brunswick City Beaches. (5) 3. Neuss River barrier protection. (5)	1. Sailors' Snug Harbor Institution. (5) 2. Marina construction at Bogue Bay - bulkhead & breakwater at Neuss River. (2)	1. Marsh building. (5)
POTENTIAL		1. Marine nurseries. (5) 2. Creation of rookeries. (5) 3. Erosion prevention. (5)		

* Parenthetical numbers refer to source of information; see page 24 for explanation.

TABLE 4.1
GENERAL ECONOMIC PROFILE
SELECTED DATA
NORTH ATLANTIC STATES

	MARYLAND	VIRGINIA	DELAWARE
1970 Labor Force	1,538,766	1,714,250	210,927
% Manufacturing	19.5	22.4	29.7
% Wholesale & Retail	19.2	18.0	19.2
% Construction	6.6	7.4	7.6
% Government	25.7	23.5	15.3
% Other	25.8	25.7	24.4
1970 Unemployed (%)	3.2	3.0	3.8
1967 Manufacturing			
Extablishments	3,401	4,938	528
Value added *	3,718.3	4,067.7	958.4
1967 Retail trade			
Establishments	25,009	32,315	4,048
Sales *	5,804.6	6.150.2	916.9
1969 Agriculture			
Average size of farm (Ac.)	163	165	182
Value of production	333.5	535.1	128.4
1969 Medium family income	11,057	9,044	10,209
Total Number of Families	974,143	1,162,256	136.915
Mineral Industries			
Establishments	136	737	13
Value added *	52**	262.6	**
% Fuels	7	56	0
% Non-Fuels	93	41	100
% Metals	0	3	0

* Millions of dollars.
** Maryland figure includes Delaware.
Source: U.S. Bureau of the Census, County and City Data Book., 1972.

TABLE 4.1 Cont.
GENERAL ECONOMIC PROFILE
SELECTED DATA
NORTH ATLANTIC STATES

	NEW JERSEY	NEW YORK	PENNSYLVANIA
1970 Labor Force	2,858.967	5,699,201	3,810,999
% Manufacturing	32.0	24.2	34.1
% Wholesale & Retail	19.2	19.6	18.8
% Construction	5.4	4.8	5.4
% Other	25.8	30.6	24.8
1970 Unemployed (%)	3.8	4.0	3.7
1967 Manufacturing			
Establishments	14,740	34,329	15,768
Value added *	12,738.2	20,157.4	16,192.5
1967 Retail Trade			
Establishments	61,321	129,755	89,370
Sales *	11,362.5	23,273.2	14,273.2
1969 Agriculture			
Average size of farm (Ac.)	122	196	142
Value of Production *	209.7	479.9	458.1
1969 Medium Family Income	11,403	10,609	9,554
Total Number of Families	1,838,809	3,687,710	2,529,349
Mineral Industries			
Establishments	138	233	1020
Value added *	70.1	87.7	474.7
% Fuels	1	3	60
% Non-Fuels	88	90	25
% Metals	11	7	15

* Millions of dollars.
** Values adjusted on proportional basis between Great Lakes and North Atlantic Region.
Source: U.S. Bureau of the Census, County and City Data Book., 1972.

TABLE 4.2
MATERIAL SUPPLY
NORTH ATLANTIC REGION

USACE DISTRICT	MAINTENANCE	NEW WORK
New York	3.4	13.8
Philadelphia	17.8	22.2
Baltimore	1.6	14.5
Norfolk	5.4	21.7
TOTAL	28.2	72.2

* Quantity figures in millions of cubic yards/year.
Source: Boyd, M.B., et al, H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972.

TABLE 4.3
SOURCE OF MATERIAL
NORTH ATLANTIC REGION

Source	New York	Philadelphia	Baltimore	Norfolk	Total
Outer Bar, Entrance Channel	0.2 *	----	----	0.1	0.3
Bay Channel	1.8	8.0	0.8	1.4	12.0
Embayed River Mouth	1.0	0.1	----	2.9	4.0
River Channel	----	1.7	----	----	1.7
Harbor	0.3	8.0	0.8	0.6	9.7
Intracoastal Waterway	0.1	----	----	0.4	0.5
TOTAL	3.4	17.8	1.6	5.4	28.2

* Quantity figures in millions of cubic yards/year.
Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 4.4
QUALITY OF MATERIAL
NORTH ATLANTIC REGION

Material	New York	Philadelphia	Baltimore	Norfolk	Total
Mud, Clay, Silt, Topsoil, Shale	2.3 *	4.8	1.5	3.3	11.9
Silt and Sand Mixtures	0.3	1.3	0.1	----	1.7
Sand, Gravel, Shell	0.8	3.7	----	2.1	6.6
Organic Muck, Peat, Wastes	----	----	----	----	----
Mixed	----	8.0	----	----	8.0
TOTAL	3.4	17.8	1.6	5.4	28.2

* Quantity figures in millions of cubic yards/year.

Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 4.5*

BALTIMORE, MARYLAND

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Southern section of Baltimore City reclaimed in past. (5) 2. Used as residential and commercial fill in many areas of Eastern Shore of Maryland. (4)	1. Beach nourishment at Ocean City, Maryland.(2) 2. Wildlife Is. in Sinepuxent Bay. (2)	1. 500 Ac. filled as industrial land by Bethlehem Steel since 1947. (3) 2. Hawkins Pt. industrial fill. (3) 3. Maryland Port Authority (MPA) has been filling Dundalk Marine Terminal (DMT) for 20 years. (3) 4. Fill at Washington International Airport. (3)	1. Land reclamation at Bivalve, Maryland. (5)
PROPOSED	1. Fill for proposed development of Outer Harbor - residential, commercial, community facilities. Lazaretto Pt. Park. (5)	1. Proposed Hart-Miller Island (H-M) Dike 100 million cu. yds. rec. development. (5) 2. Quarry fill at diked marsh on Potomac River. (2) 3. Marsh creation at Slaughter Creek. (2) 4. Quarry fill in coastal areas. (5)	1. Further expansion of port facilities. (2) 2. Heliport construction in D.C. (1)	1. Research into brick manufacture and aggregate use. (5) 2. Stockpiles for further use as fill. (5) 3. Fertilizer & topsoil. (3)
POTENTIAL	1. Fill for housing and commercial expansion throughout area. (5) 2. Fill for inner harbor development - all uses. (5)	1. Strip mine fill. (5)	1. Fill for E-W Expressway in Baltimore. (2) 2. Fill for rapid transit in Baltimore. (5)	1. Erosion protection for Poplar Island Group in Chesapeake Bay. (3)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 4.6*

NEW YORK

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. 2.5 million cu. yds. used for development of Long Island. (1) 2. Bulkhead fill for commercial fill in East R. near Newtown Creek - 90,000 cu. yds. (5)	1. 3 million cu. yds. used for beach constr. on Long Island. (1) 2. 1.3 million cu. yds. used for beach nourishment on Long Island. (1)	1. Bulkhead constr. in Suffolk Co., N.Y. and in Hackensack R. (2) 2. Expansion of berthing facilities in Brooklyn 2.7 million cu. yds. (5)	1. 5 mil. cu. yds. used in sand & gravel on Long Island. (1) 2. Martin-Marrieta aggregates Div. Dredging Hudson R., Tomkin Cove & Haverstraw. (5)
PROPOSED	1. 50-60,000 cu. yds. fill needed for residential construction at Haverstraw, N.J. (3) 2. Multi-use development of Hackensack Meadows using dredgings as fill and to combat landfill fires. (3)	1. Proposed beach nourishment on Hudson at Kingston, N.Y. and on Long Is. and Salem, N.J. (3) 2. Sanitary landfill cover. (4) 3. Filled parks along Hudson in Westchester Co., N.Y. (2)	1. Recommendations for several secondary airports. (1) 2. Containerport development. (1) 3. Water-oriented industrial fill. (1) 4. W. Side Hwy. project. in Manhattan. (3)	1. Artificial islands for wetlands. (4) 2. Sand & gravel resource. (2) 3. Research at Yale University on building materials. (2)
POTENTIAL	1. Fill for housing and commercial expansion throughout area. (5)	1. Strip mine and quarry reclamation. (1)	1. Fill for transportation development. (5) 2. Industrial fill. (1) 3. Power plant sites. (5)	1. Possible use in brickmaking and sand & gravel industry.

* Parenthetical numbers refer to source of information; see page 24 for explanation.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS
TABLE 4.7*

NORFOLK, VIRGINIA

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Used for urban development along Va. shores of Chesapeake Bay. (1)		1. Craney Is. Dike - 120 million cu. yds., 2500 Ac. - probably port facilities. (5) 2. Used in construction of dock facilities at Newport News. (2)	1. City of Richmond stockpiles dredging from James R. for future fill. (2) 2. Lone star ind. using dredgings as sand and gravel resource. (2)
PROPOSED	1. Offshore resort islands. (2)	1. Dismal swamp fill site 170 million cu. yds., 5000 acres will be recreational use. (1) 2. Borrow pit fill. (1) 3. Beach nourishment at Virginia Beach 1/4 million cu. yds. 4. Sanitary landfill cover. (1)		1. Reclamation of swampy areas. (1) 2. Creation of offshore Islands for military resort use. (1) 3. Flood control dikes along James R. (2) 4. Creation of agricultural lands from brush lands. (4)
POTENTIAL		1. Marsh development near mouth of James River. (2)	1. Highway embankments. (1)	1. Fertilizer. (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

PHILADELPHIA, PENNSYLVANIA

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 4.8*

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Dredged fills for industrial sites along Del. River. (5)	1. Dredgings used for coastline stabilization at Woodland Beach, Del. (4)	1. Highway stabilization at Port Mahon, Del. (4) 2. Phila. Airport constructed on dredged fill. (5) 3. Artificial Island nuclear power plant constructed partly of dredged fill. (5)	1. Dredgings sold as fill in Phila. (2) 2. Numerous hydraulic fill areas along Del. River near Nortonville Del. (5) 3. Del. R. Mar'l. N. of Phila. used by N.J. as fill. (5)
PROPOSED	1. Fill for industrial sites along Del. R. (4) 2. Fill for urban renewal in Scranton area. (4) 3. Industrial and residential development Scranton area (4) 4. Residential, comm., ind. fills in Phila. area. (4) 5. Proposed superport in Delaware Bay. (5)	1. Quarry fill throughout region - 100's of quarries. (2) 2. Fill strip mines with dredgings and junked cars. (4) 3. Recreational fills. (4) 4. Sanitary landfill cover - New Castle Co., Del., Phila., Pa. (4) 5. Recreational fills along Delaware coast. (4) 6. Marsh creation on Delaware Coast. (4) 7. Riverfront Park in Phila. (4) 8. Beach nourishment-N.J. (4)		
POTENTIAL				1. Tree farms, nurseries agricultural lands. (4) 2. Possible use in glass production. (4) 3. Concrete aggregate. (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

TABLE 5.1
GENERAL ECONOMIC PROFILE
SELECTED DATA
GREAT LAKES STATES

	N.Y.**	PA.**	OH.	MICH.
1970 Labor Force	1,424,800	725,904	4,063,780	3,252,830
% Manufacturing	24.2	32.1	35.6	35.9
% Wholesale & Retail	19.6	18.8	19.2	19.4
% Construction	4.8	5.4	5.0	4.8
% Government	16.8	13.2	13.1	13.7
% Other	30.6	24.8	23.1	20.3
1970 Unemployed	4.0	3.7	4.0	5.9
1967 Manufacturing				
Establishments	8,582	3,003	15,428	14,340
Value added *	5,049.3	3,084.3	20,435.4	17,241.5
1967 Retail Trade				
Establishments	32,439	17,023	51,199	63,569
Sales *	5,818.3	2,799.6	16,295.3	14,114.4
1969 Agriculture				
Average Size Farm (Ac.)	196	142	145	153
Value of Production *	479.9	458.0	1,196.4	796.5
1969 Medium Family Income				
Number of Families	921,928	481,781	2,691,130	2,190,269
Mineral Industries				
Establishments	234	1,021	1,195	459
Value Added *	87.8	474.7	401.3	483.7
% Fuels	3	60	43	10
% Non-metals	90	25	57	56
% Metals	7	15	0	34

* Millions of dollars.

** Values adjusted on proportional basis between Great Lakes and North Atlantic Region.

Source: U.S. Bureau of the Census, County and City Data Book., 1972

TABLE 5.2
MATERIAL SUPPLY
GREAT LAKES REGION

USACE DISTRICT	MAINTENANCE	NEW WORK
Buffalo	4.4	2.7
Detroit	4.7	5.5
TOTAL	9.1	8.2

* Quantity f gures in millions of cubic yards/year.
Source: Bc yd, M.B., et at., H-72-8 USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 5.3
SOURCE OF MATERIAL
GREAT LAKES REGION

SOURCE	BUFFALO	DETROIT	TOTAL
Harbor	3.9 *	1.2	5.1
River or Lake Channel	0.4	3.0	3.4
River Channel or Canal	0.1	0.5	0.6
TOTAL	4.4	4.7	9.1

* Quantity figures in millions of cubic yards/year.
Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 5.4
QUALITY OF DREDGED MATERIAL
GREAT LAKES REGION

MATERIAL	BUFFALO	DETROIT	TOTAL
Mud, Clay, Silt, Topsoil, Shale	0.9 *	0.4	1.3
Silt and Sand Mixtures	3.5	2.3	5.8
Sand, Gravel, Shell	—	2.0	2.0
Organic Muck, Peat, Wastes	—	—	—
Mixed	—	—	—
TOTAL	4.4	4.7	9.1

* Quantity figures in millions of cubic yards/year.

Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 5.5*

BUFFALO, NEW YORK

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING		1. Construction of earthen dikes in town of Lancaster by CE for flood control. (5) 2. Levees and landfills along Red Creek in Rochester for flood control. (5) 3. Huron recreation area. (5) 4. Beach nourishment at Fair Haven Beach and at Hamlin Beach w. of Rochester and Vermillion. (2) 5. Times Beach Dike to become Park. (2)	1. Existing diked disposal area slated for port expansion. 2. Construction of break waters and groins at Cat-araugus Creek for small boat harbor; also same at Hamlin Beach. (2) 3. 250 ac. light industrial land filled by Port Authority. (3)	
PROPOSED	1. Lackawanna Industrial Landfill. (3) 2. 1.3 million cu. yds., land-fill in Erie Harbor proposed by City of Erie for commercial development. (4) 3. Presque Isle-Eire, Pa. - Fill for badly eroding abandoned sand pits. State Park Dept. wants to develop as marina. (5) 4. Landscaping w/fill to enhance beauty of Niagara Falls area. (2) 5. Residential and commercial expansion expected at Grand Island. (5)	1. Daily cover for sanitary land-fills. (3) 2. 7 ac. basin filled w/20 ft. of water. State Park officials have requested to have filled w/dredgings to within 3' of water surface (200,000 yd^3) to be used for ice skating in winter (Presque Isle Peninsula-Erie). (5) 3. Flood protection levees at Watkins Glen. (5) 4. Recreational development along Tonawonda Creek. (3) 5. Erosion protection. (5)	1. Proposed joint deposition of dredgings with slag from Bethlehem Steel Co. to create new land in Harbor area. Land to be used for industrial expansion. (2) 2. Industrial expansion planned for area around Buffalo International Airport. 3. Use in highway and rapid transit devint. (4) 4. Creation of wildlife area at Lehigh Valley Basin. (3)	1. Clarence sand & gravel, Clarence, N.Y. interested in exploring use of dredgings in sand and gravel industry. (1) 2. Flood protection landfills in Cuyuga River. (5) 3. Experiments successful for use as topsoil in Park land-scaping. (2)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

BUFFALO, NEW YORK

POTENTIAL

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS
TABLE 5.5 (Cont'd.)

URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
1. Construction fill for residential and commercial development in Amherst, N.Y. (5) 2. Fill for new University of Buffalo campus at Amherst. (5)	1. Park landscaping, hills for sleuding. (5) 2. Fill for golf course construction. (5) 3. Possible fill for marshes east of Power Reservoir. 4. Possible fill for sand pits and quarries around towns of Clarence and Collings, N.Y. (1)	1. Fill for possible regional jetport in Buffalo Area. (5) 2. Possible future expansion of industrial facilities at Lackawanna. (3)	1. Enrichment of low quality agricultural lands. (5) 2. Stockpiling for future residential and commercial fill requirements.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 5.6*

TOLEDO, OHIO

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING			1. 480,000 cu. yds. dredged and placed along Maumee River Shoreline as part expansion land. Bulkhead and dock built by Toledo-Lucas Co. Port Authority. (5)	
PROPOSED	1. Proposed commercial. development at Cedar Pt. near Sandusky. (5) 2. Proposed commercial development in marshes at Bay View E. of Sandusky. (5) 3. New municipal facilities planned for S.E. section of Sandusky. (5) 4. Proposed residential expansion in Sandusky. (5)	1. Replenishing eroded shoreline at Oregon, Ohio and Cedar Pt. on Lake Erie. (4) 2. Proposal by Erie Wild-fowlers to create wildlife refuges in Maumee Bay with dredged material. (4) 3. Cover material for proposed sanitary landfills in Sandusky area 190 ac. by 1990. (5) 4. Proposed recreational development along shore. (5) 5. Erosion Protecton between Sandusky & Huron. (4)	1. Industrial expansion planned in Sandusky Harbor. (5) 2. Proposal to fill 3100 acres parallel to Maumee Bay channel to create additional dock facilities (7.5 million cu. yds.) (5)	
POTENTIAL	1. Possible industrial development on reclaimed marshes at North Maumee Bay. (5) 2. Possible industrial development between Toledo and Sandusky on marshes. (5) 3. Possible residential expansion throughout area. (4)	1. Fill for quarries located inland of Toledo and in Sandusky area. (3,4) 2. Possible reclamation of marsh lands at Muddy Creek Bay-w. of Sandusky. (5) 3. Strip mine fill. (4) 4. Floodplain fill. (1)	1. Major expansion of highway system throughout Sandusky area. (4) 2. Possible future expansion of harbor lands.	1. Stockpiling for future residential and commercial fill requirements. (5) 2. Fertilizer or topsoil. (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 5.7*

CLEVELAND OHIO - (Including Canton, Akron, Youngstown)

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING			1. Existing dike to be used for airport. Extension (Cleveland). (2)	
PROPOSED	1. 233 ac. landfill (2.2 mil. cu. yds.) in City of Ashtabula near Harbor. Site would be used for commercial development when fill is consolidated. (5)	1. Land use plans call for conversion of quarry area S. of Youngstown to park areas. (5) 2. Erosion protection on shores of Great Lakes. (5) 3. Gordon Park Recreational development. (2)	1. Proposed Lake Erie airport at Cleveland. (2) 2. Authorized C. of E. project to develop small boat harbor on west side of Conneaut Harbor. (2) 3. Possible use of Ravenna Arsenal land as airport site. (5)	
POTENTIAL	1. 1800 new housing units per year projected for suburban Youngstown. (20,000 ac. additional by 1990). Also 3,300 Ac. of new commercial development projected by 1990. (5)	1. Fill needed for strip mines in Akron area. (5) 2. Numerous mines and quarries around Canton particularly S.E. of city, 15,000 ac. of strip mined land. (5) 3. 7,000 ac. stripmined land in Mahoning Co. near Youngstown. (5) 4. 2.1 million cu. yds. recreational landfill in Conneaut Harbor. (5) 5. 2.2 million cu. yds. offshore landfill at Ashtabula for recreational development. (5) 6. Possible cover for sanitary landfills. (5)	1. 800 ac. of new industrial land recommended for Youngstown, Ohio to accomodate expected expansion. (5)	1. Stockpiling for future residential and commercial fill requirements. (5)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 5.8*

DETROIT, MICHIGAN (And Surrounding Area)

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING		1. Sand from dredging has been used for beach nourishment along Michigan shoreline (N. of Saginaw Bay). (5) 2. Dikes have been built of dredged material to protect wildlife areas from erosion in Wayne and Monroe Counties (Mouille Marsh). (5)	1. 2 million cu. yds. used as fill on w. side of Saginaw River for industrial use. (1)	
PROPOSED	1. Fill for 280 acres of marshy, undeveloped land at mouth of River Raisin to 9' above present level. Would be used for public purposes. (4)	1. Mich. DNR and Corps considering use in barrier beach for shoreline protection and beach nourishment. (4) 2. Two large city parks built from dredged material at Point Moulet in Detroit R. and Dickinson Is. in Lake St. Clair. Facilities planned for fishing, boating, picnicking. (2) 3. Erosion protection on shores of Great Lakes. (5) 4. Beach nourishment. (2)	1. Several diked areas planned for lower Detroit River to be used small boat harbor.(280 ac-3.7 mill. cu. yds.). (5)	1. 3 million cu. yds. pumped into marshes w. of mouth Saginaw River to reclaim land. (5)
POTENTIAL	1. Residential and commercial expansion is to be expected throughout area. (5)	1. Possible use as mine fill in Kent Lake area and N. of Detroit. (4) 2. Expansion of erosion control in wildlife areas. (5) 3. Expansion of recreational areas in outlying areas to be expected. (4) 4. Possible cover for sanitary landfills. (5) 5. Mi 'ill. (4)	1. Possible industrial development on marshy areas along banks of River Raisin at Monroe. (5) 2. Industrial lands in N.E. Michigan are expected to double in next 20 yrs. (5) 3. P ssible use in highway projects. (4)	1. Extraction process to secure sand from dredgings for sand & gravel industry. (4) 2. Stockpiling for future residential or commercial fill. (5) 3. Large areas in Wayne Co. could be used as agricultural land if soil could be enhanced. (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

TABLE 6.1
GENERAL ECONOMIC PROFILE
SELECTED DATA
PACIFIC COAST STATES

	WASHINGTON	OREGON	CALIFORNIA
1970 Employment			
% Manufacturing	21.6	21.4	21.6
% Wholesale & Retail	21.5	22.1	21.1
% Construction	6.1	5.8	5.4
% Government	19.0	7.0	6.3
1970 Unemployed	7.2	7.0	6.3
1967 Manufacturing			
Establishments	5014	4437	31,962
Value Added *	$3,764.2	$2,060.5	$23,393.6
1967 Retail Trade			
Establishments	27,104	18,836	162,376
Sales *	$5,465.6	$3,346.9	$33,498.2
1969 Agriculture			
Average Size Farm (Ac.)	516	620	459
Value of Production *	$758.2	$518.6	$3,875.2
1967 Mineral Industries			
Establishments	185	160	1,438
Value of Production *	$28.7	$35.1	$1,687.8
1969 Median Family Income	$10,404	$9,487	$10,729

* Millions of dollars.

Source: U.S. Bureau of the Census, County and City Data Book., 1972

TABLE 6.2
MATERIAL SUPPLY
PACIFIC COAST REGION

USACE DISTRICT	MAINTENANCE	NEW WORK
Seattle	3.3 *	3.4
Portland	13.7	13.9
San Francisco	7.1	36.5
TOTAL	24.1	53.8

* Quantity figures in millions of cubic yards/year.
Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 6.3
SOURCE OF MATERIAL
PACIFIC COAST REGION

SOURCE	SEATTLE	PORTLAND	SAN FRANCISCO	TOTAL
Outer Bar, Entrance Channel	0.4	3.6	1.1	5.1
Bay Channel	1.1	0.3	0.5	1.9
River Channel	0.8	7.1	5.4	9.1
Intercoastal Waterway	-----	-----	-----	-----
TOTAL	3.3	13.7	7.1	24.1

* Quantity figures in millions of cubic yards/year.
Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

TABLE 6.4
QUALITY OF MATERIAL
PACIFIC COAST REGION

MATERIAL	SEATTLE	PORTLAND	SAN FRANCISCO	TOTAL
Mud, Clay, Silt, Topsoil, Shale	0.1 *	2.5	4.8	7.4
Silt and Sand Mixtures	1.0	0.1	1.1	2.2
Sand, Gravel. Shell	2.2	11.1	1.2	14.5
Organic Muck, Peat, Wastes				
Mixed	—	—	—	—
TOTAL	3.3	13.7	7.1	24.1

* Quantity figures in millions of cubic yards

Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS
TABLE 6.5*

WASHINGTON

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Homes built on bulk-heads & fill. (4) 2. Fill marsh lands. (4)	1. Fill to develop lands Dept. Nat. Res. (4) 2. Beach nourishment. 3. Creation of Rookeries. (5) 4. Creation of artificial is., Skagit County. (5) 5. Aberdeen Boat Ramp & Area. (5)	1. Industrial area-Shelton, Wash. built on dredgings. (4) 2. Dredged stockpile for highway embankment. (4) 3. Fill for commercial site (Dept. Nat. Res.) 4. Columbia River dredged by Willamette Hi-Grade Co. for concrete production. (4) 5. Portions of Tacoma & Seattle Port facilities. (5) 6. Portions of Grays Harbor Port. (5)	1. Provide storage sites for material they hope to sell (Dept. Nat. Res.) (4) 2. Smith Island Disposal Site. (4) 3. Fee paid to State to use disposal areas. (4) 4. Seattle City Light stockpiling for sale. (2)
PROPOSED	1. Dike around Aberdeen Wash.-flood control. (4) 2. Fill low areas Swinomish Indian Reservation. (4, 2,3)	1. Park development of Reed Island. (4) 2. Park Development on Vancouver La. using spoil from stockpile. (4) 3. Wind River Boat Ramp. (4) 4. Rock Creek Fair Ground. (4) 5. Drano Lake Boat Ramp. (4) 6. Big White Salmon R. (4) 7. Create artificial Is. (5)	1. Camas-Washougal fill (300,000 cu.yds.) 50 ac. tract for industrial development. (4) 2. Dike & Fill area of Columbia R. Vancouver Lakes Lowlands for industrial use. (4) 3. Fill in areas of port of Willapa Harbor. (4)	1. Fill Ediz Hook, Port Angelos 108,000 cu. yds. Initial, 13,000 annual. (4)
POTENTIAL	1. Pump spoils to Colorado R. Gorge Cliffs for agricultural & residential use. 2. Raise yards above ground water (Aberdeen). (4) 3. Residential site-Skagit County. (3)	1. Increase wild fowl land (Rookeries). (4) 2. Beach nourishment-Aberdeen, Wash. (4) 3. Create new beachs. (4) 4. Sanitary landfill cover. (4) 5. Use sand & gravel for shell-fish & clams. (4) 6. Strip mine fill at Centralia. (4) 7. Fill in parks. (4)	1. Highway embankment. 2. Agricultural topsoil along Col. River. (4) 3. Raise existing air-strip Aberdeen, Wash. (4) 4. Create new boat basin Aberdeen, Wash. (4) 5. Commercial sites-Skagit County. (5)	1. Sell spoil (Dept. of Nat. Res.) (4) 2. Mulch for cranberry crops. (4) 3. Source of Gravel-County of Clallam. (4) 4. Source of Sand-Skamania County. (4) 5. Green River Valley-if developed would require preload fill. (3)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

PORTLAND, OREGON

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS
TABLE 6.6*

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Create new lands for real estate development. (4) 2. Fill low lands for light residential. (1)	1. Develop marginal lands. (4) 2. Recreational parks. (4) 3. Sanitary landfills. (1,4) 4. Create islands as rookeries. (4,1) 5. Prevent erosion to existing shorelines. (4) 6. Created fishing beaches. (4)	1. Commercial & industrial sites. (1,4) 2. Roadway embankment. 3. Improving structural foundations. (4) 4. Portland Airport extended w/spoil. (1) 5. Parking lots. (1) 6. Winchester Bay Boat Basin. (5) 7. Doane, Kittredge & Guild. Lakes filled. (5) 8. Industrial areas of Yaquina Bay. (5) 9. Winchester Bay. (5) 10. Areas of Reedport. (5) 11. Areas along Umpqua River. (5) 12. Rainbow Ave. built on fill. (5)	1. Sand & gravel used from Columbia R. (4) 2. Corps has been dredging & stockpiling material for varied uses. (1) 3. Created new clam beds, Coos Bay and Yaquina Bay. (4) 4. Sand used for concrete industry. (1)
PROPOSED		1. North Portland Peninsula (Rivergate) requires approx. mill. cu. yds. recreational. (3,5) 2. Fil' S E. end of Swan Lake (Stagnant Area). 3. Fill Ross Island-presently being removed by mining. (3)	1. Port of Skamania County could use 1.5 mill. cu. yds. to raise 45 acres above 100 year flood plain. (2) 2. North Portland Peninsula (Rivergate) requires approx. 15 mill. cu. yds. industrial fill. (3,5)	
POTENTIAL		1. Creation of artificial islands & building up of existing islands, erosion prevention in Columbia River. (2)	1. Port of Cascade Lock could use 1 to 2 mill. cu. yds. of material on Port property. (4) 2. Port of Dalles could use 1.5 to 3 mill. cu. yds. on Port Property. (3) 3. Klickitat County Port could use 1.5 to 3 mill. cu. yds. (4) 4. Proposed airport fill at Coos Bay. (5)	1. Sand & gravel. (4,1) 2. Agricultural land nourishment. (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

REPORTED DEVELOPMENTS ON REGIONAL LANDFILLS

TABLE 6.7*

SAN FRANCISCO, CALIFORNIA

	URBAN	ENVIRONMENTAL	ECONOMIC	RESOURCE
EXISTING	1. Development around estuarine water on dredge fill. (4,1) 2. Use dredgings in and around urban areas. (1)	1. Dikes from fill being used to protect low lying areas (Pastures). (4,1) 2. Pollutants separated & used for rookeries. (Tidal). (1) 3. Upland areas also enhanced for wildlife (Non-Tidal). (1) 4. Dredgings used to develop parks. (1) 5. Candlestick Park. (1) 6. Bay filling at Emeryville. (5) 7. Beach nourishment. (5)	1. Development around estuaries on dredge fill. (4) 2. Land extension for condominiums. (1) 3. Roadway embankment for roads contiguous to rivers being dredged. (1) 4. Industrial & commercial. 5. Foster City, Calif. was built on dredged fill. (1) 6. San Leandro built on fill. (2) 7. Hunter's Point Naval Ship Yard. (3) 8. Dike built w/dredgings & debris. Dredged layer to keep sulphides from leaching out. (3) 9. Sausalito & Richardson Bay.	
PROPOSED		1. Beach nourishment. (5)	1. Moss landing required 0.5 mill. cu. yds. (3) 2. 3 miles above Moss Landing-require 3 mill. cu. yds. fill. (4)	
POTENTIAL	1. Combine dredged material w/solid waste & rebuild levees in San Joaquin Delta. Delta. (4) 2. Hunter's Point Ridge Housing Development. (3)	1. Rebuild eroding beaches. (4) 2. Sanitary landfill. (4,3) 3. Possibly use certain dredgings for dam construction. (4) 4. Fill certain existing salt beds & return them to marshland. (2) 5. Reclaim dredged tailings. (4)	1. Transportation Dept. use of poor material to flatten earth embankment. (4) 2. Fill for new development. (4) 3. Bay View Industrial Plant. (4) 4. Port of San Francisco container Port-Islais Creek. (3) 5. Flint-Koat Co. could use certain dredged material. (4)	1. Sand used for sub-base materials-stockpiles & sold. (4,1) 2. Need aggregate material for construction. 3. Bolster levees in Sacromento-San Joaquin Delta for agriculture. (4)

* Parenthetical numbers refer to source of information; see page 24 for explanation.

TABLE 7.1
SAND AND GRAVEL PRODUCTION – 1970

State	Population	Sand and Gravel Production (tons)	Per Capita Production (tons)
North Atlantic Region			
New York *	12,395,741	24,537,000	2.0
New Jersey	7,168,164	16,732,000	2.3
Pennsylvania *	6,993,681	10,972,000	1.6
Delaware	548,101	1,565,000	2.9
Maryland	3,922,399	12,951,000	3.3
Virginia	4,648,494	11,126,000	2.4
Dist. of Columbia	756,510	None	—
Regional Summary	36,433,090	77,883,000	2.1
South Atlantic Region			
Florida *	4,372,939	6,210,000	1.4
Georgia	4,589,575	3,667,000	0.8
North Carolina	5,082,059	12,772,000	2.5
South Carolina	2,590,516	5,864,000	2.3
Regional Summary	16,635,089	28,513,000	1.7
Gulf Region			
Texas	11,191,431	31,438,000	2.8
Louisiana	3,640,490	18,155,000	5.0
Alabama	3,444,165	6,725,000	2.0
Florida *	1,924,631	6,272,000	2.0
Mississippi	2,216,912	10,859,000	4.9
Regional Summary	27,282,480	67,177,000	2.5
Great Lakes Region			
Michigan	8,875,083	53,092,000	6.0
Ohio	10,631,848	42,069,000	3.9
Pennsylvania *	4,800,226	7,532,000	1.6
New York *	5,841,210	10,820,000	1.9
Regional Summary	30,168,367	113,513,000	3.8

TABLE 7.1 (Cont'd.)

State	Population	Sand and Gravel Production (tons)	Per Capita Production (tons)
Pacific Coast Region			
Washington	3,409,169	25,089,000	7.4
Oregon	2,091,385	17,532,000	8.4
California	19,957,715	140,259,000	7.2
Regional Summary	25,458,269	182,880,000	7.2

* Partial figures where one state is common to two study areas.

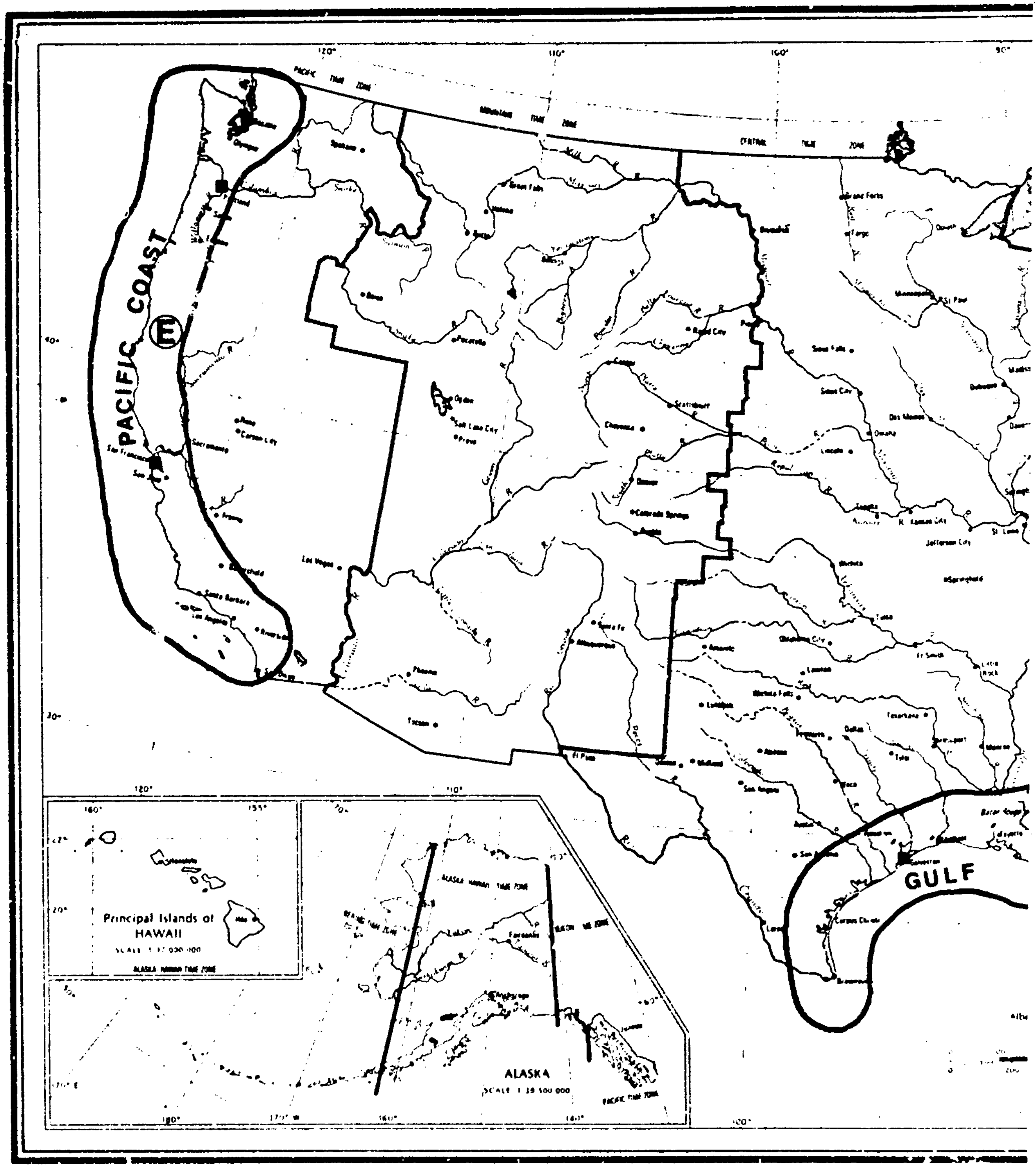
Source: U.S. Bureau of Mines.

TABLE 7.2
AVAILABILITY OF AGGREGATE MATERIAL IN CORPS DISTRICTS

	Estimated Sand, Gravel, Shell	Estimated Per Capita Availability (cu. yd.)
NORTH ATLANTIC REGION		
New York	800,000 cu. yds.	0.05
Philadelphia	3,700,000 cu. yds.	0.3
Norfolk	2,100,000 cu. yds.	0.4
Baltimore	none	0
SOUTH ATLANTIC REGION		
Wilmington	2,400,000 cu. yds.	0.4
Charleston	400,000 cu. yds.	0.1
Savannah	1,800,000 cu. yds.	0.6
Jacksonville	1,100,000 cu. yds.	0.2
GULF REGION		
Mobile	5,900,000 cu. yds.	1.3
Galveston	700,000 cu. yds.	0.2
New Orleans	none	—
GREAT LAKES REGION		
Detroit	2,000,000 cu. yds.	0.2
Buffalo	none	—
PACIFIC REGION		
Seattle	2,200,000 cu. yds.	0.8
Portland	11,100,000 cu. yds.	6.5
San Francisco	1,200,000 cu. yds.	0.1

Source: Boyd, M.B., et al., H-72-8, USAEWES, CE, Vicksburg, Mississippi, 1972

PLATES



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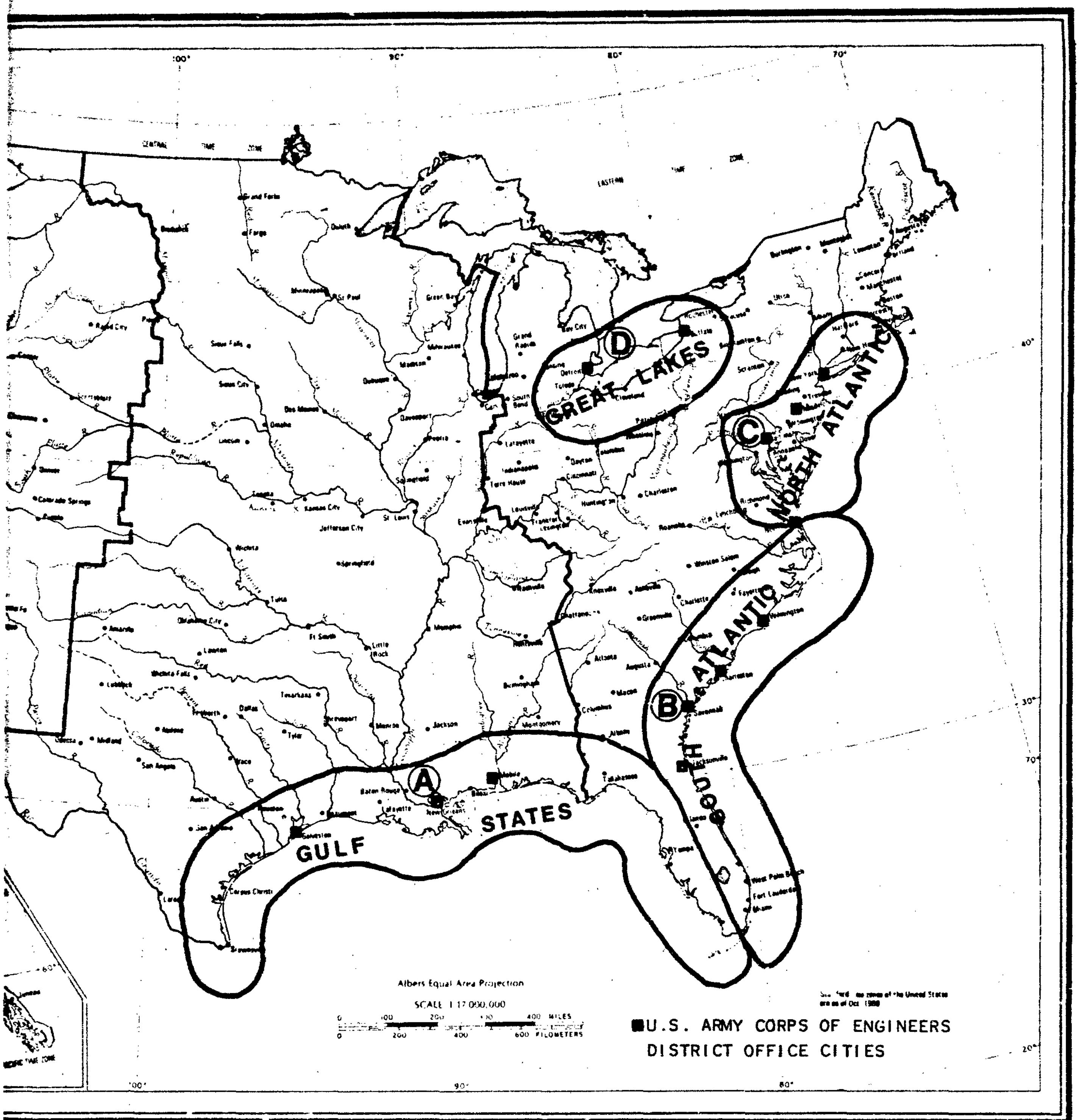

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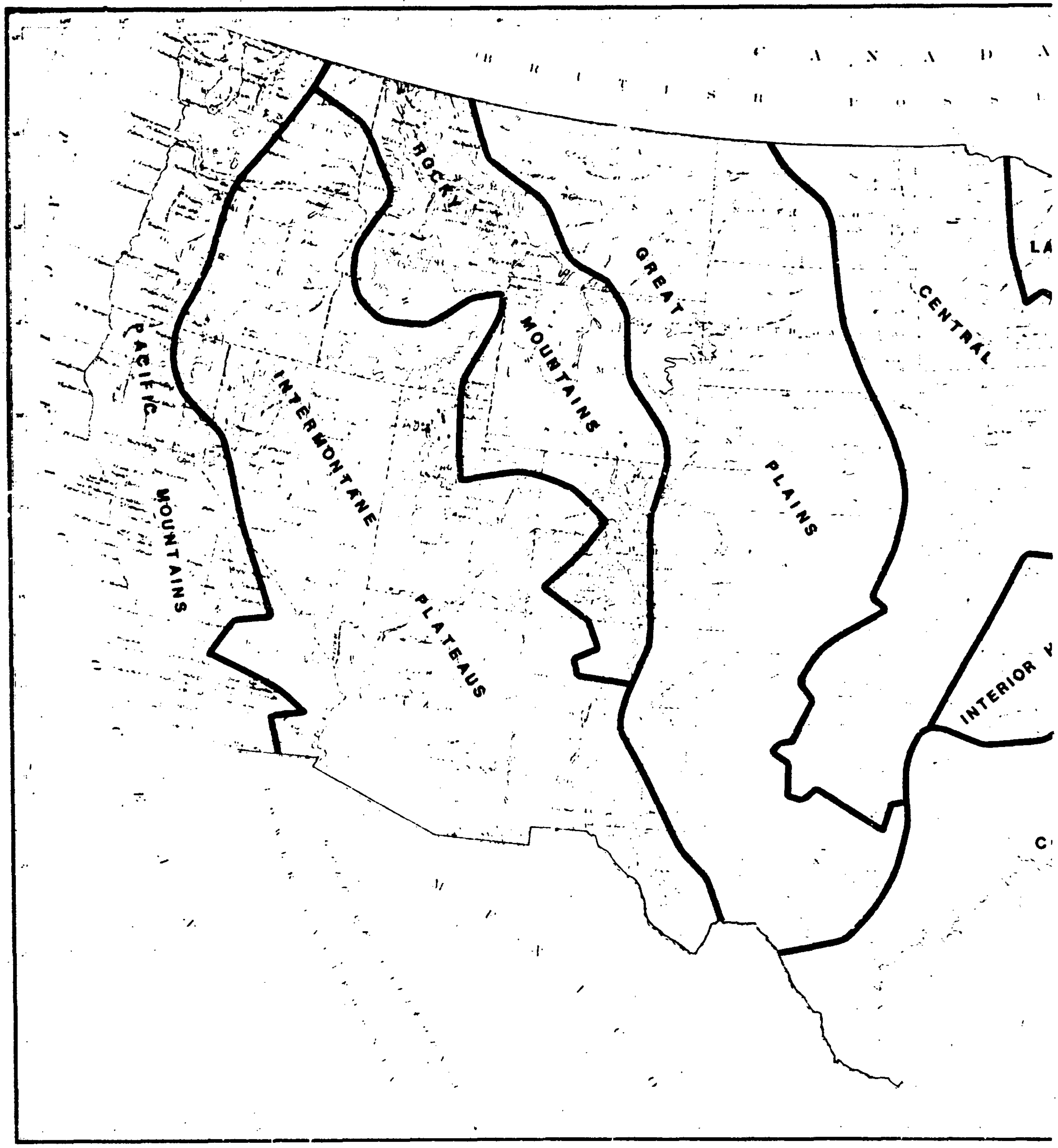

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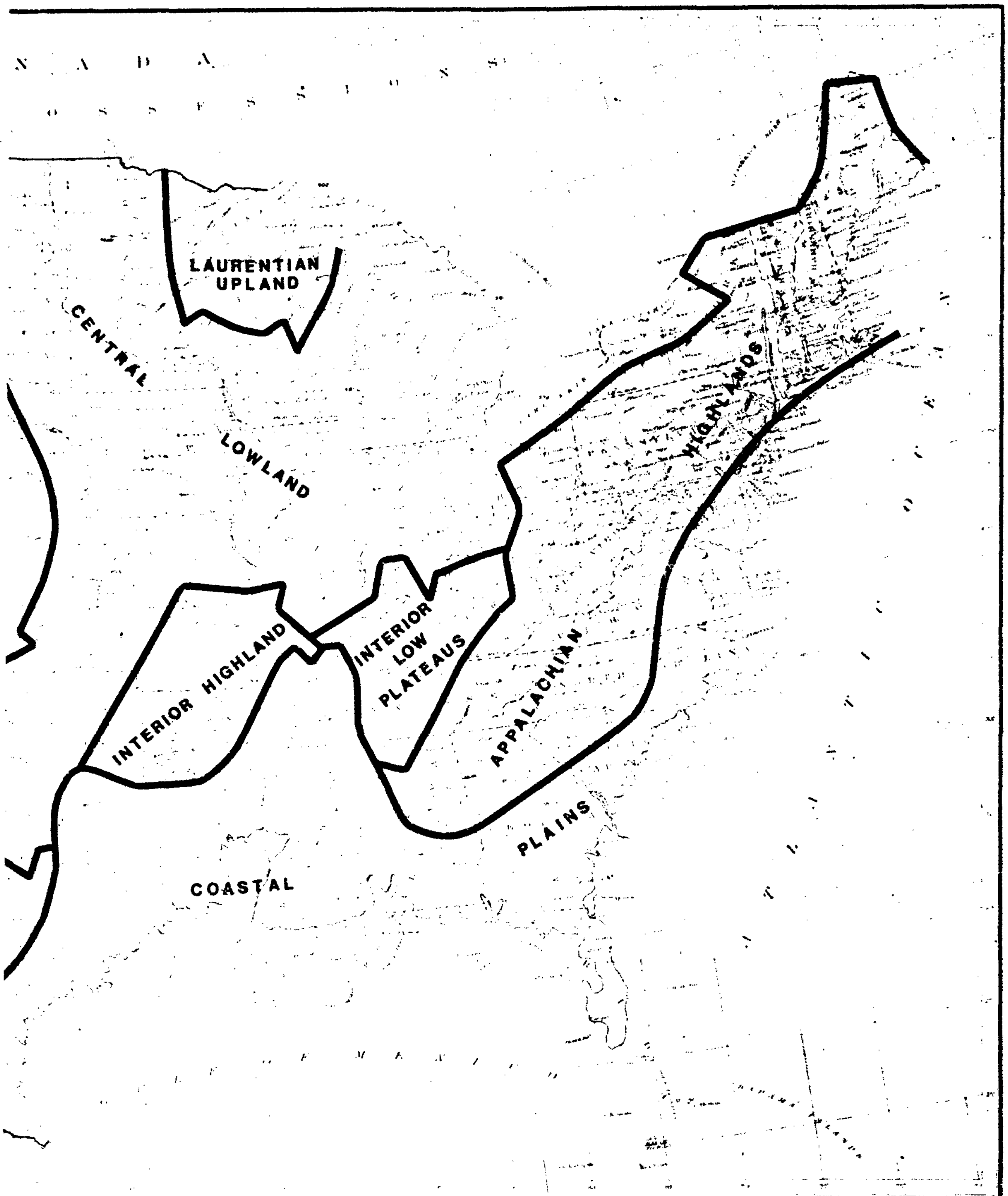

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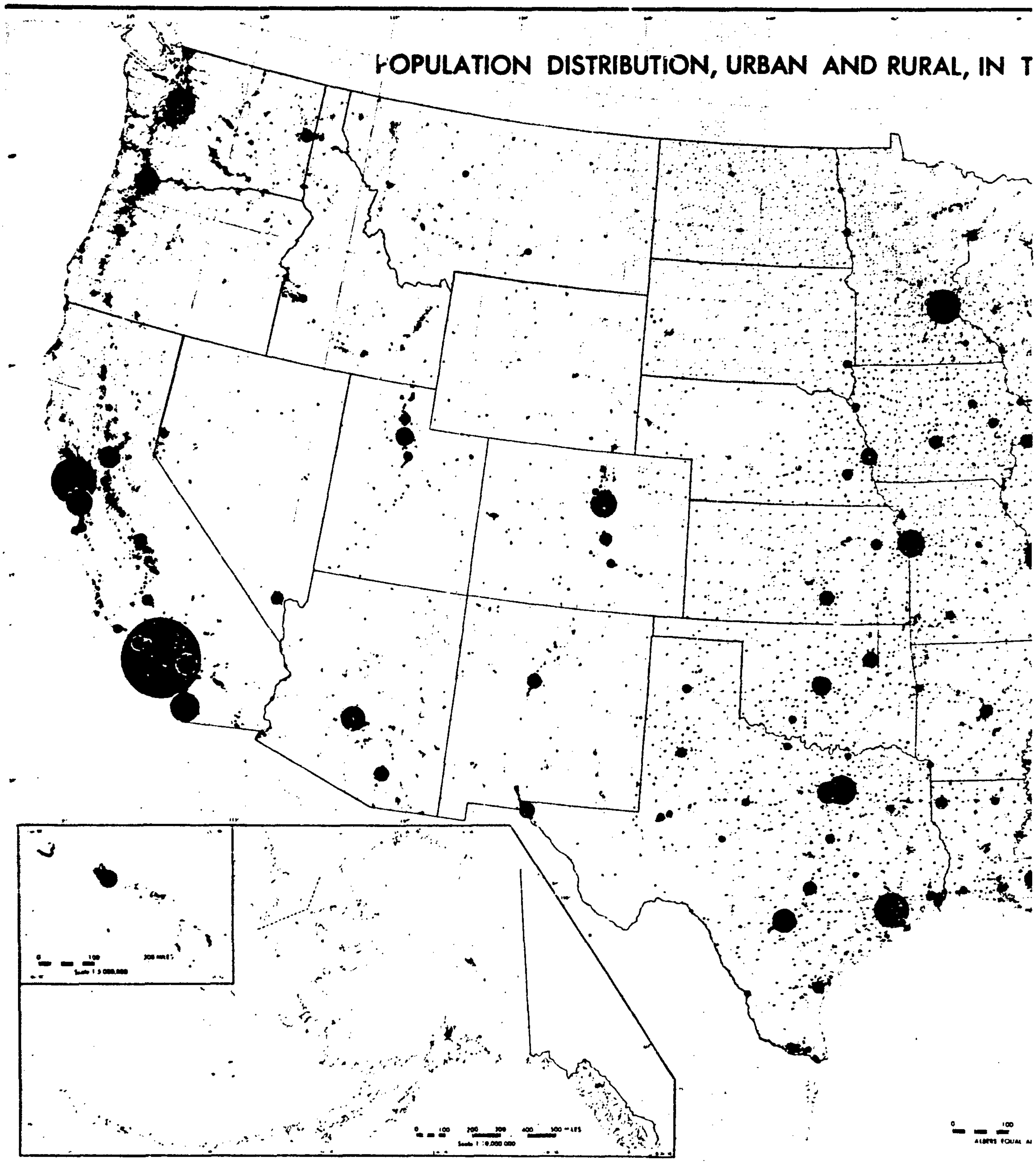

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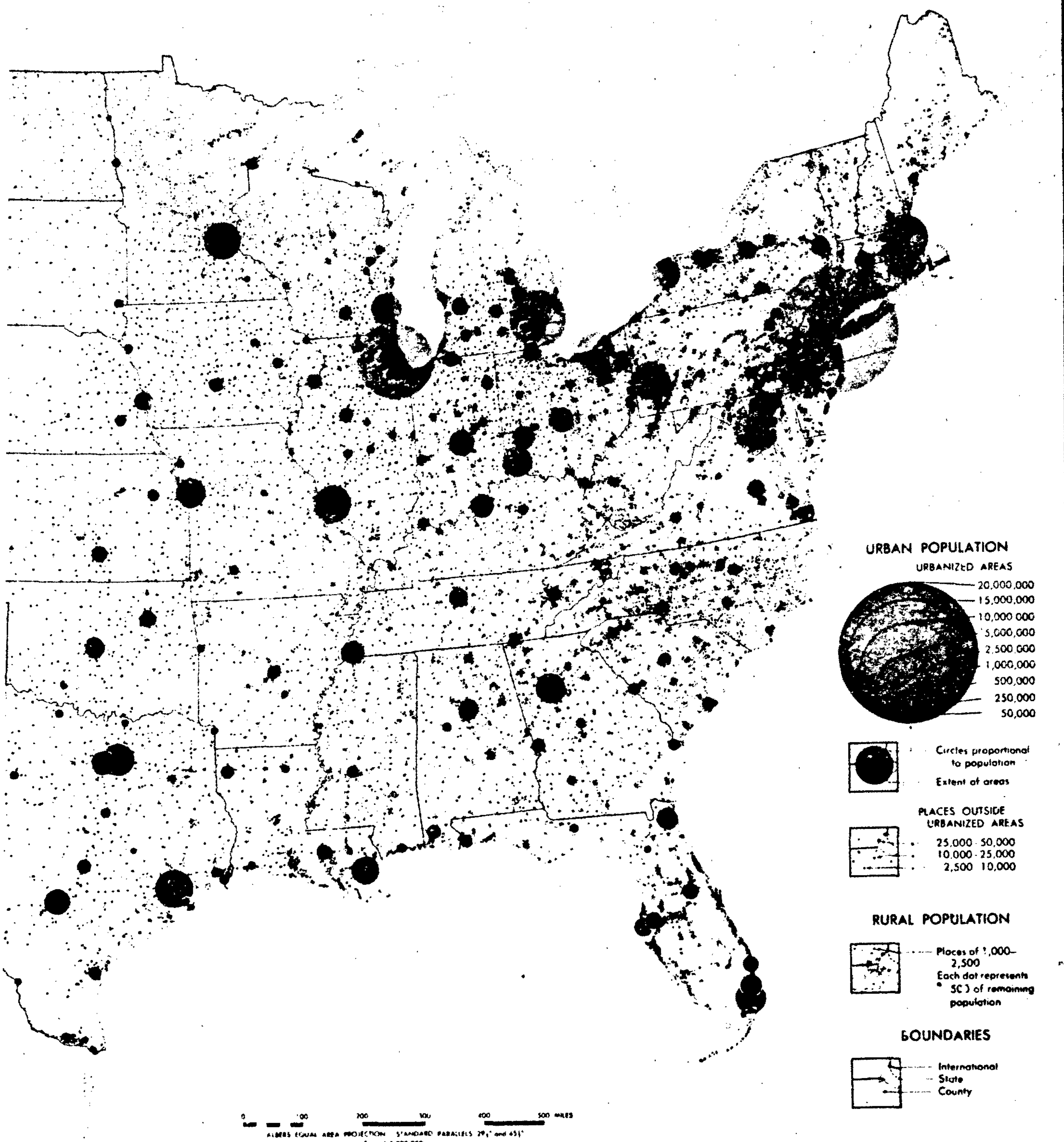

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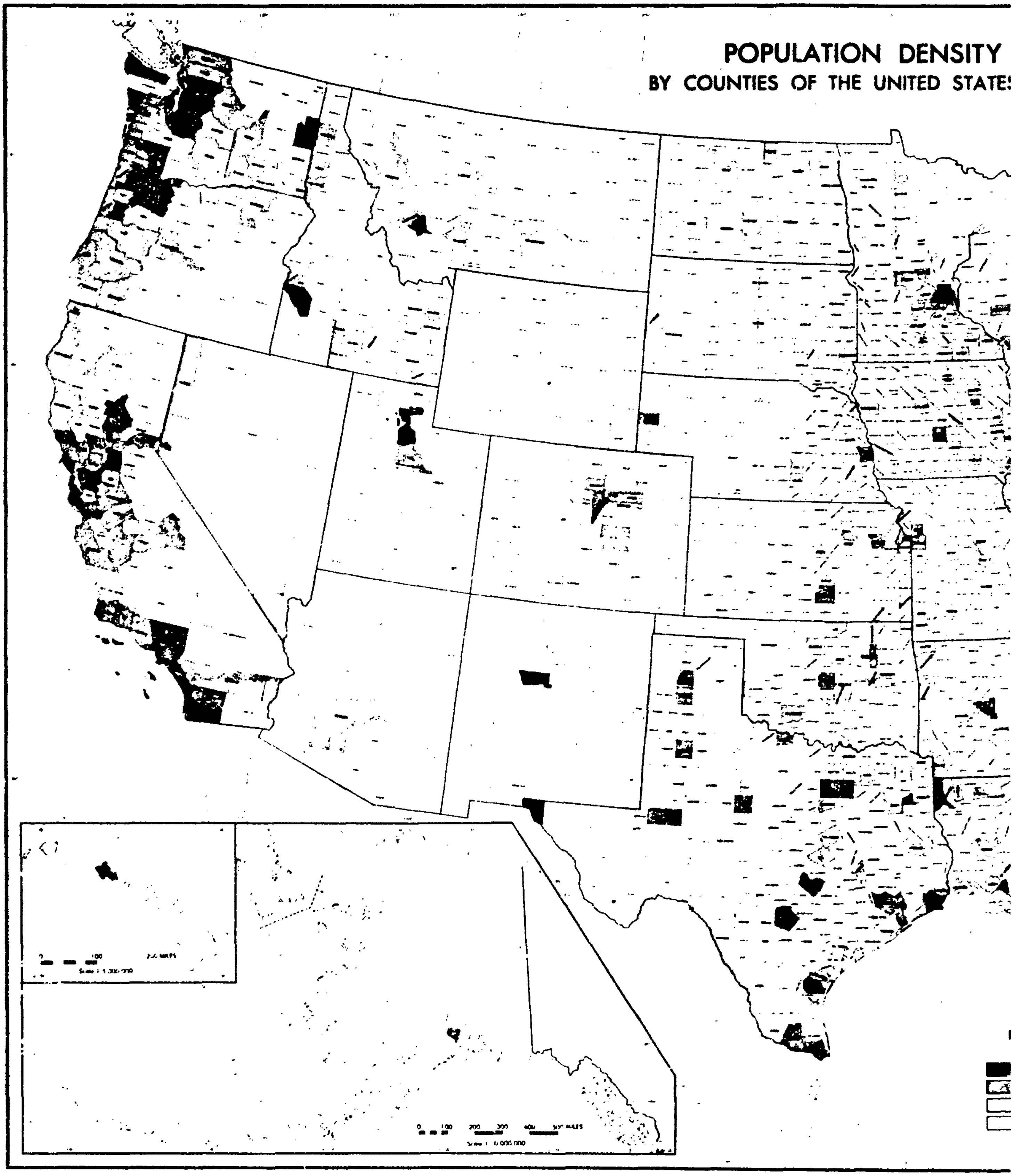

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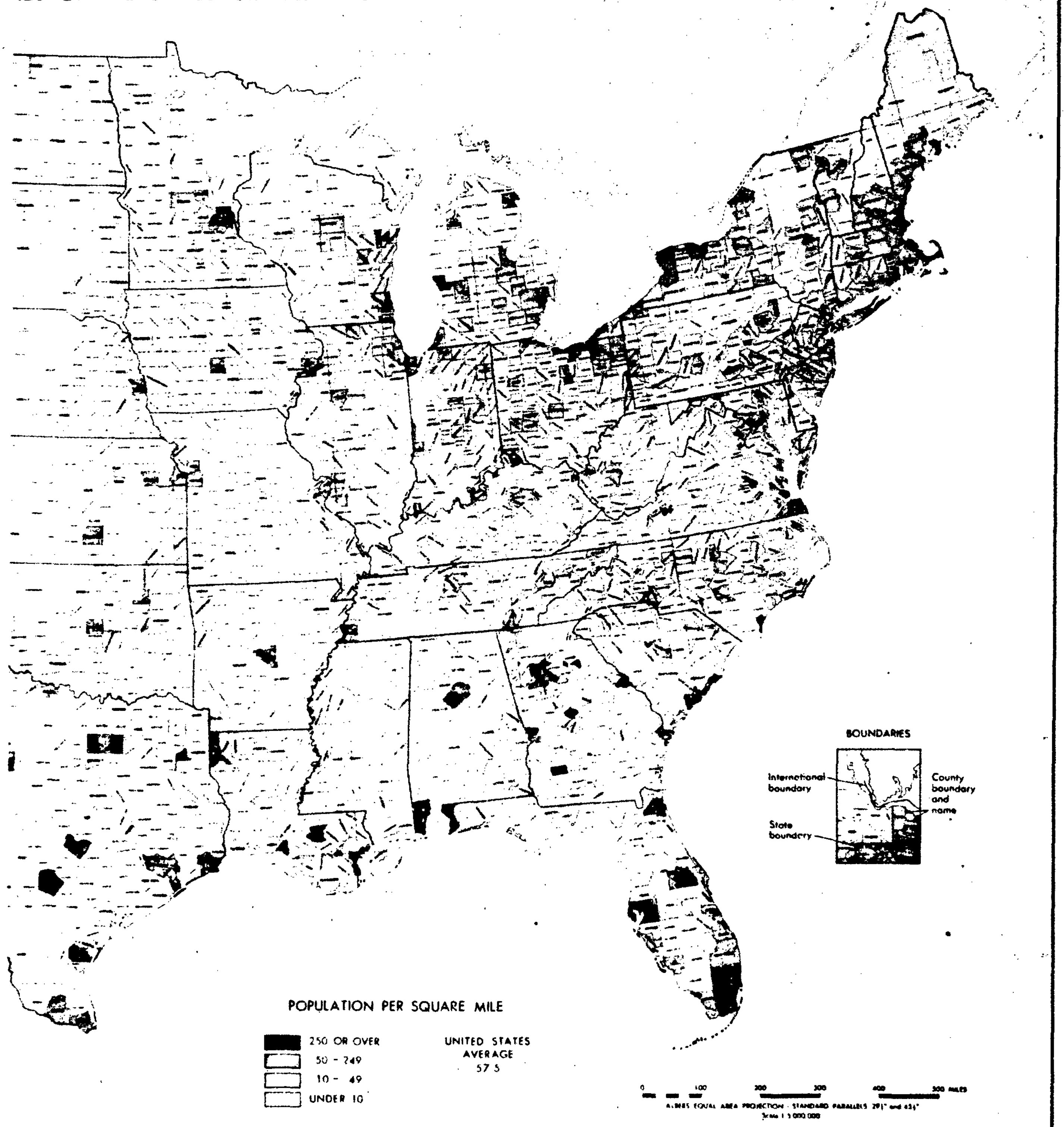

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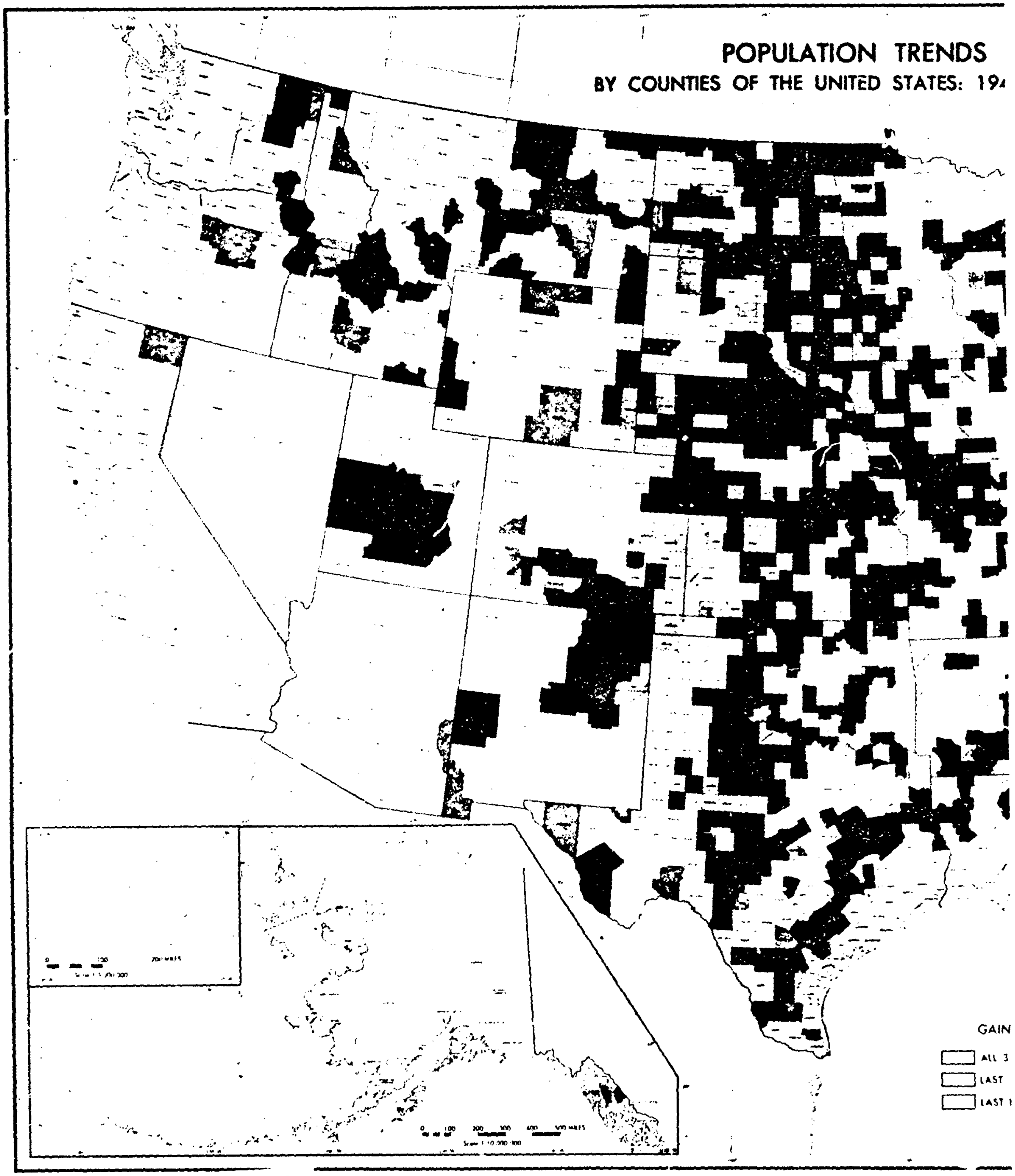

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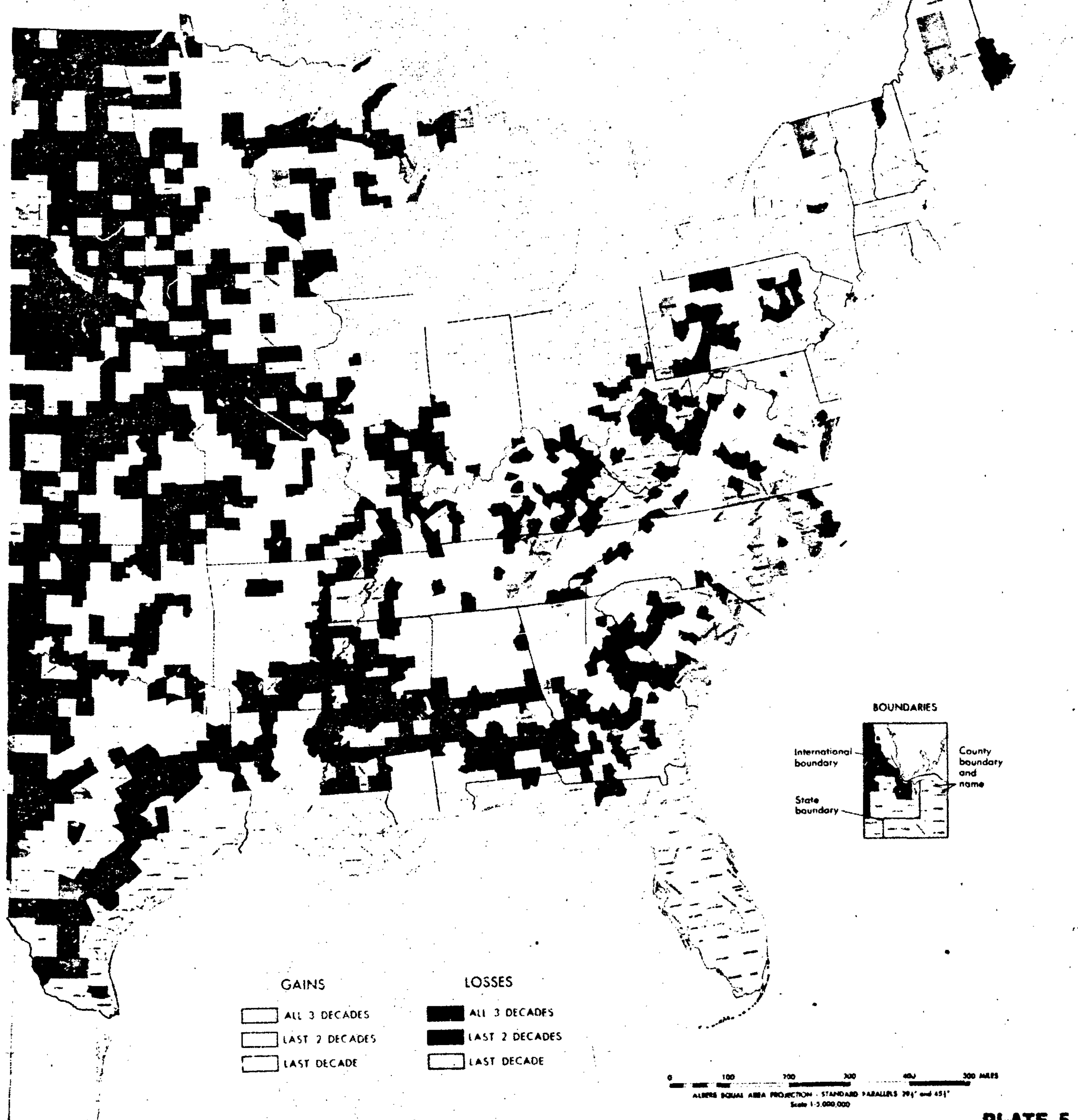

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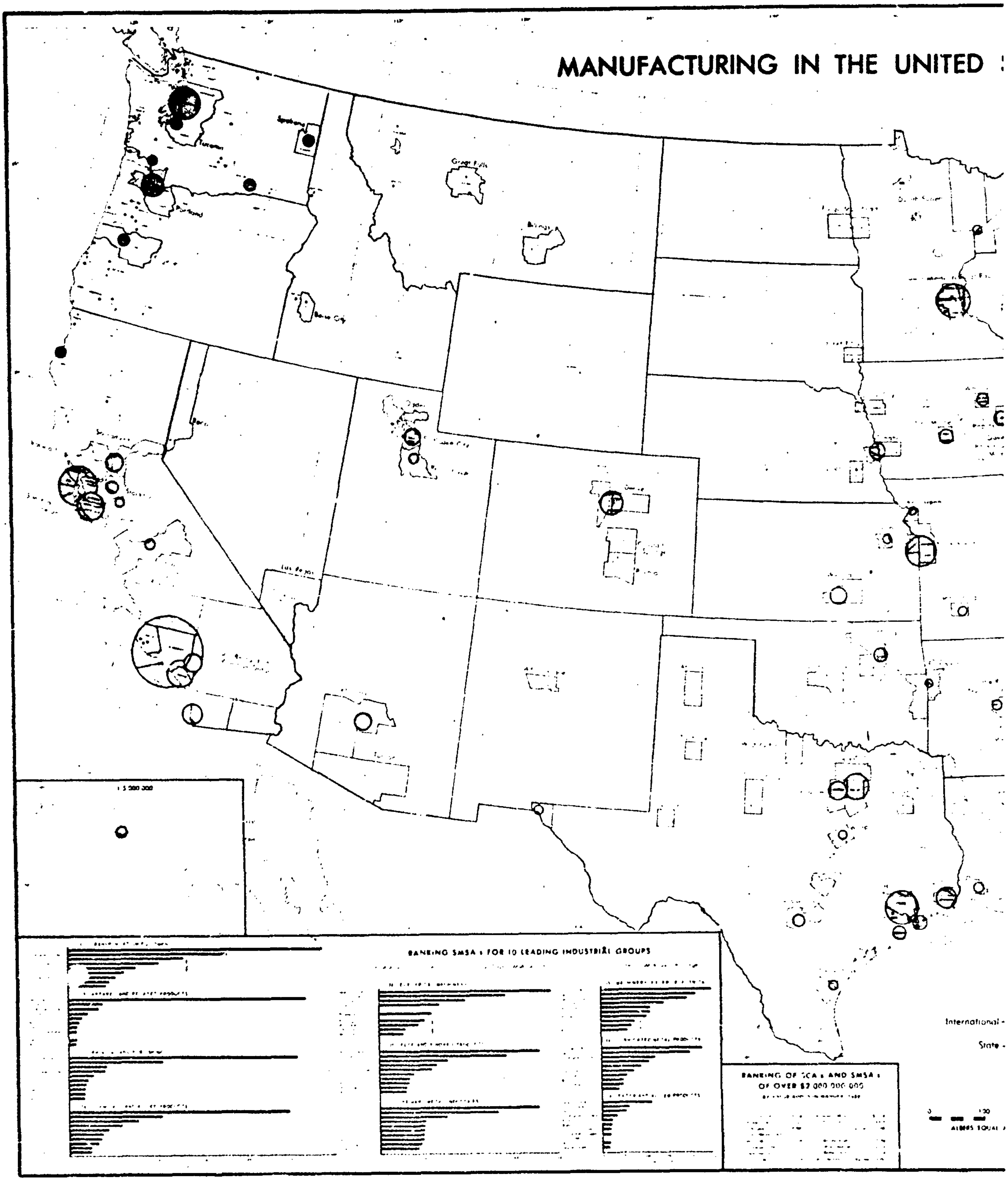

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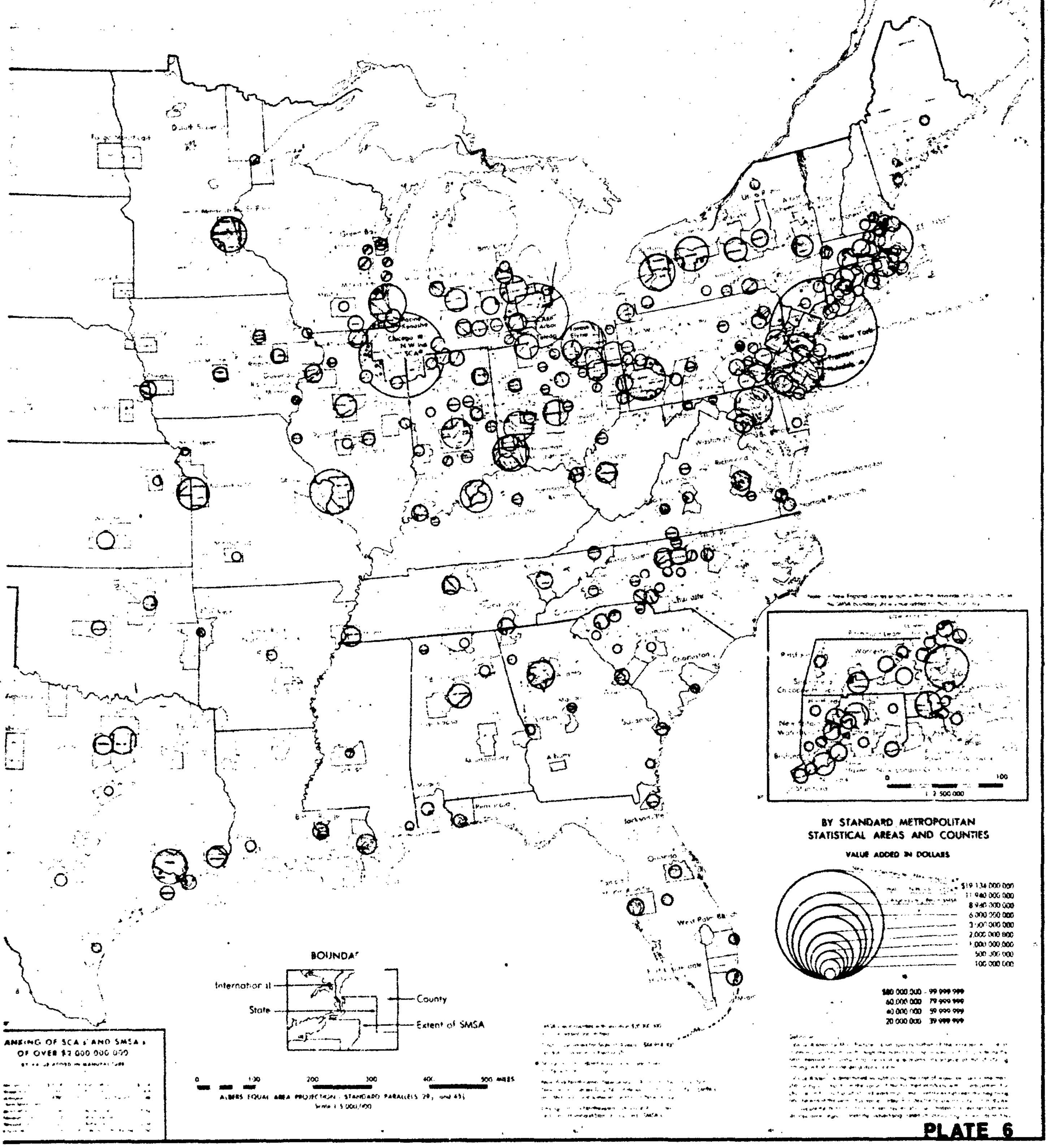

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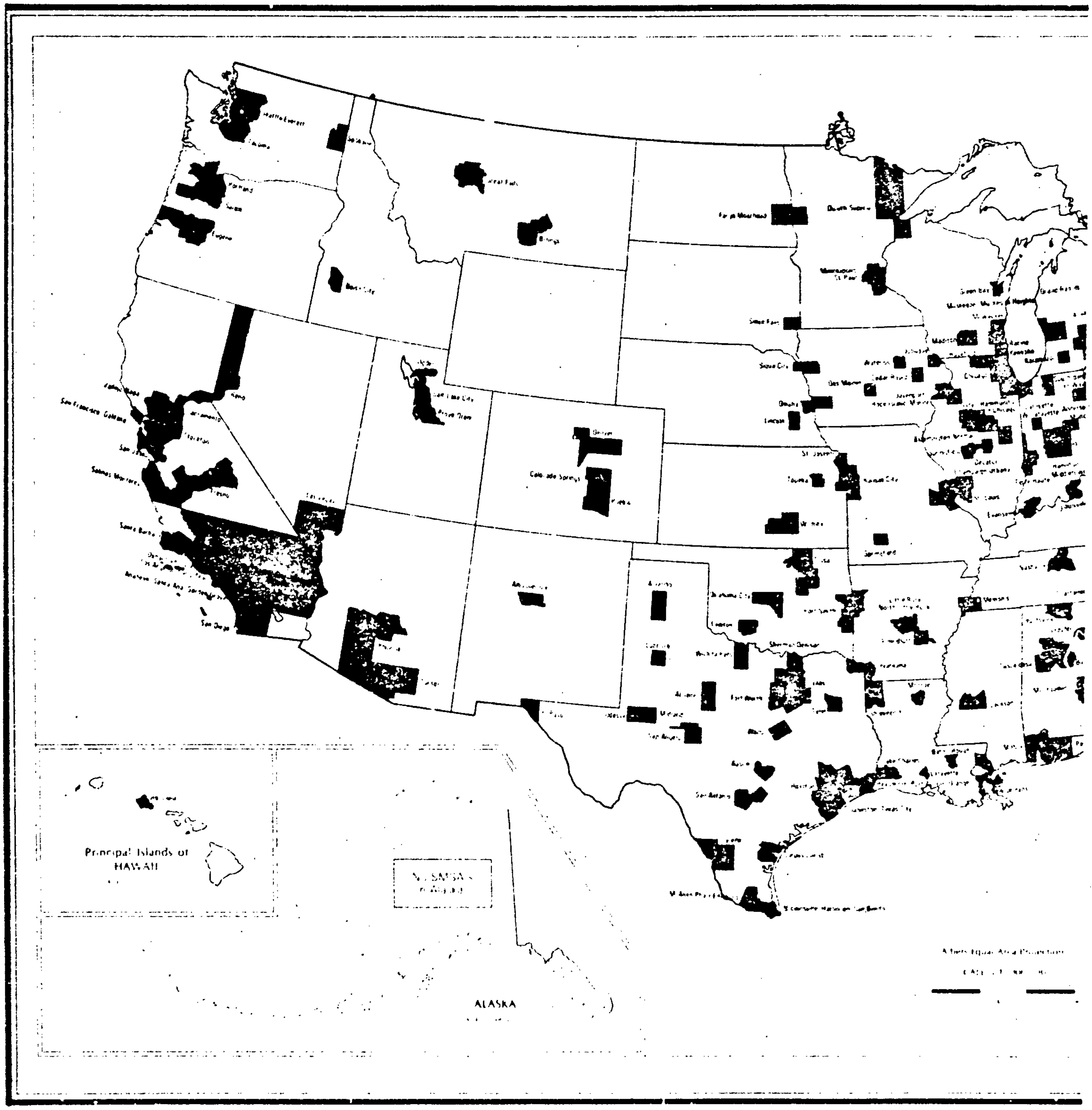

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Plate 7 Standard Metropolitan Statistical Areas

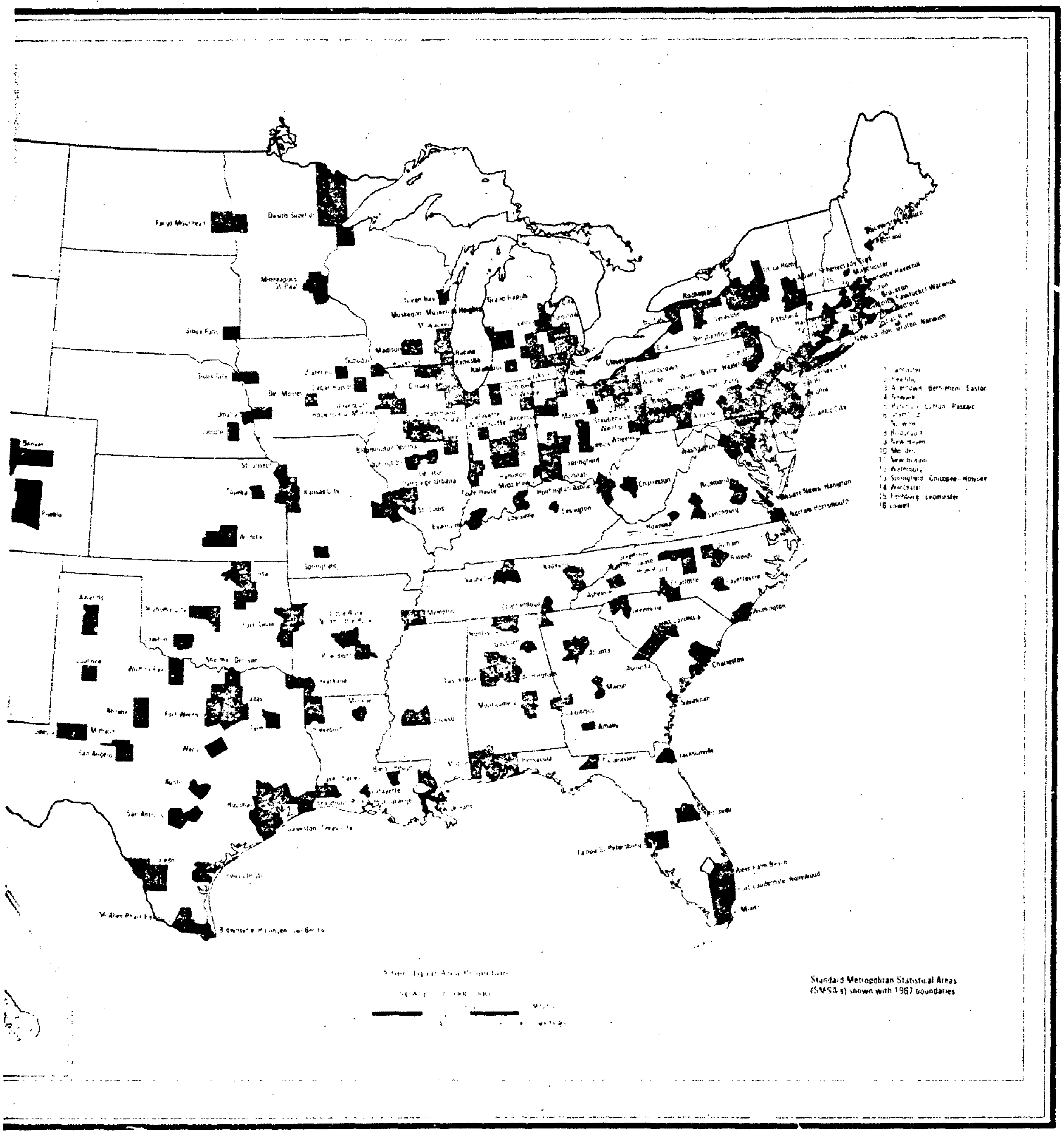
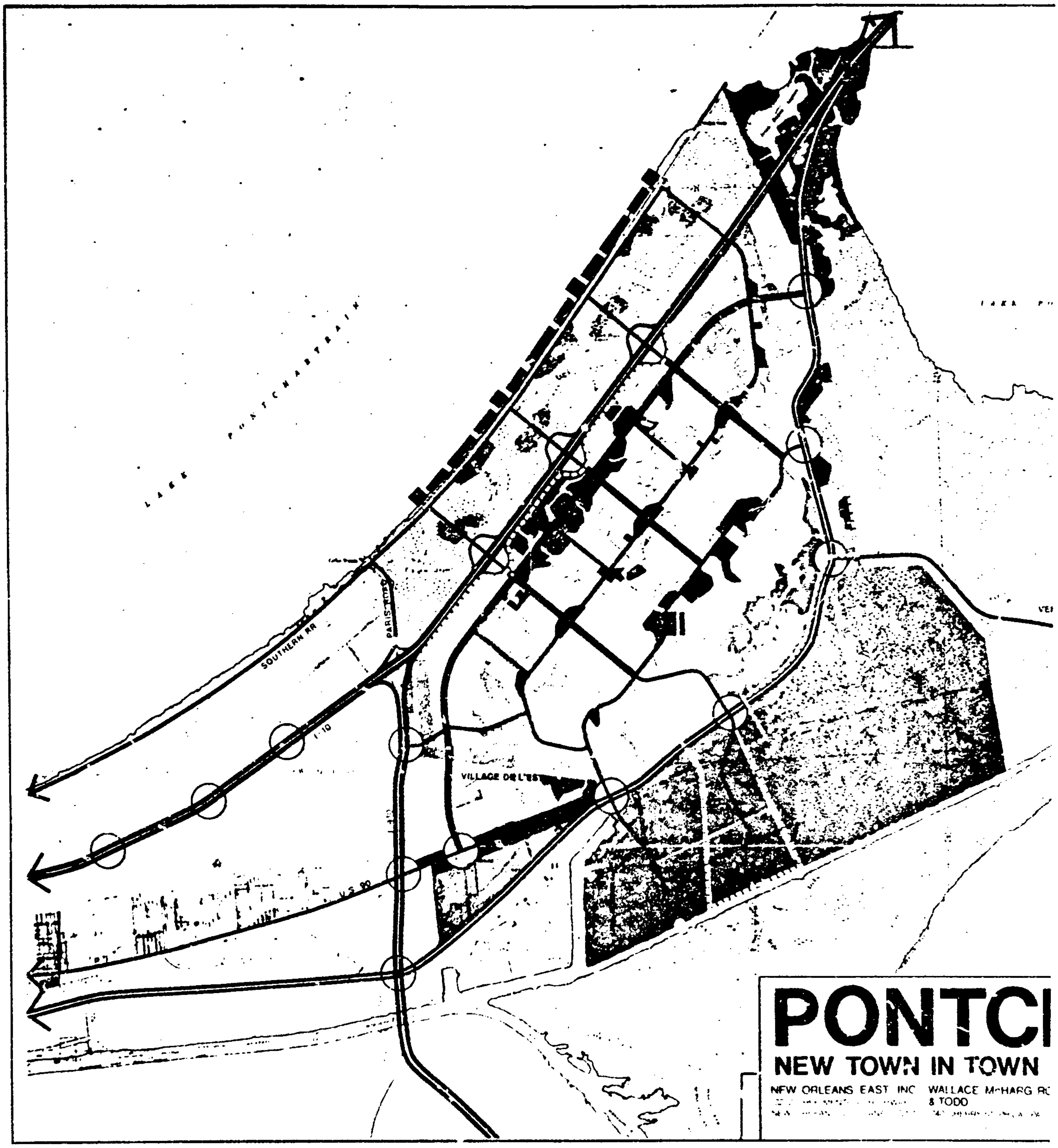


Plate 7 **Standard Metropolitan Statistical Areas**



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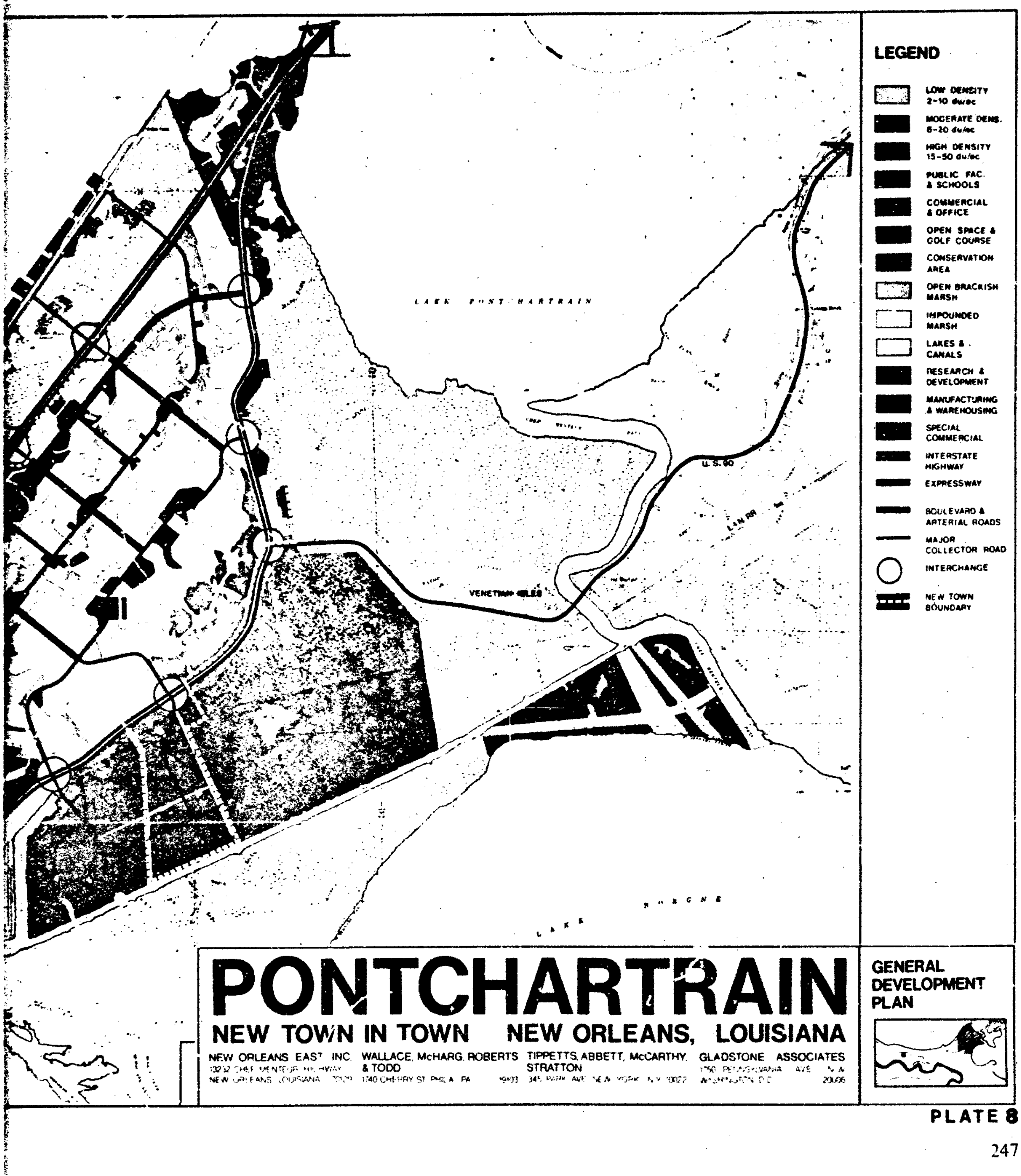
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MODERATE DENS. 8-20 du/ac
HIGH DENSITY 15-50 du/ac
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OPEN BRACKISH MARSH
IMPOUNDED MARSH
LAKES & CANALS
RESEARCH & DEVELOPMENT
MANUFACTURING & WAREHOUSING
SPECIAL COMMERCIAL
INTERSTATE HIGHWAY
EXPRESSWAY
BOULEVARD & ARTERIAL ROADS
MAJOR COLLECTOR ROAD
INTERCHANGE
NEW TOWN BOUNDARY
LAKE PONTCHARTRAIN
U.S. 90
VENETIAN ISLES
LAKE BORGNE
PONTCHARTRAIN
NEW TOWN IN TOWN NEW ORLEANS, LOUISIANA
NEW ORLEANS EAST INC.
NEW ORLEANS, LOUISIANA
WALLACE, McHARG, ROBERTS & TODD
1740 CHERRY ST. PHILA. PA
TIPPETTS, ABBETT, McCARTHY, STRATTON
345 PARK AVE. NEW YORK
GLADSTONE ASSOCIATES
WASHINGTON D.C.
GENERAL DEVELOPMENT PLAN

PLATE 8

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